Computer-Assisted Analysis of Old Testament Texts: The Contribution of the WIVU to Old Testament Scholarship

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1. Introduction

The 'Werkgroep Informatica' at the Faculty of Theology of VU University Amsterdam (WIVU) occupies a distinct position in Old Testament scholarship in the Netherlands since its foundation in 1977. Building up an electronic database of the Masoretic Text of the Old Testament, the WIVU developed a powerful instrument for biblical scholars to explore the Hebrew Bible. In addition, the members of the WIVU made clear why computer-assisted research is relevant for the study of the Old Testament. They showed that a database provides an instrument for Semitists, exegetes, and Bible translators to analyze the linguistic patterns in a text, without paying too much attention to the literary composition in which they are employed. As a result, the analysis of the text will be more based on the available textual data, and, as a result, less *ad hoc*.

The close connection between the WIVU database and the methodological line of thinking is possibly the main reason why the WIVU persisted during the last thirty-five years, while several other computer projects that started in the seventies and the eighties of the previous century did not survive.[2] A further reason may be the fact that this approach was used not only for the analysis of the Hebrew text of the Old Testament, but also for other ancient Semitic texts, both biblical and non-biblical.

Describing the history of the WIVU, this paper intends to show the close relationship between the WIVU database and its methodological line of thinking. In doing so, it seeks to explain how the WIVU developed in the course of time and how it will deal with the challenges of the near future.

2. The WIVU Database

The WIVU was founded by Eep Talstra in 1977 and remained under his direction until his retirement in 2011. The main purpose of the WIVU was to contribute to the study of the linguistic and the literary features of the Hebrew and Aramaic text of the Old Testament by implementing the computer. The main concern was to build up a database of the Masoretic Text, so that one could search through it for linguistic features.

The text of the WIVU database is based on the scholarly edition of the Old Testament, the *Biblia Hebraica Stuttgartensia* (*BHS*),[3] which in turn is based on a single ancient manuscript, the Leningrad Codex, preserved in St. Petersburg and dating from 1009 CE. Like other manuscripts of the Old Testament, the Leningrad Codex has been written mainly in Classical Hebrew and is the product of rabbinic tradition. Some isolated words and several chapters are written in Aramaic.

The database of the WIVU follows the principle of bottom-up analysis. That means that the analysis starts with the analysis of smaller elements and builds up to the analysis of larger

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[1] With the assistance of Janet Dyk, Wido van Peursen, and Eep Talstra.
[2] Most of the computer projects that started in that period are listed in: J.J. Hughes (ed.), *Bits, Bytes, and Biblical Studies: A Resource Guide for the Use of Computers in Biblical and Classical Studies*, Grand Rapids 1987.
[3] K. Elliger, W. Rudolph (eds), *Biblia Hebraica Stuttgartensia*, Stuttgart ⁵1997.

textual units. First, the text was marked with boundary markers between morphemes and a description of all morphological forms was prepared. Patterns of morphemes are recognized as words. The information from morpheme level is added to the information at word level, including part of speech. Then the phrase and clause levels of the texts are analyzed, and, finally, the level of clause hierarchy, which deals with the connections between clauses, compound clauses, and sentences.[4] The analysis of the elements in a text is meant to reflect the process of reading. The connections between the various clauses and sentences show how a reader is guided through the textual composition.

When preparing the text database, the grammatical form is given priority over the grammatical function. Unlike other computer projects that add grammatical tags to the elements of the computer text in order to label their grammatical function, the WIVU lets the computer identify and analyze the elements of the text on the basis of their composite elements and distribution and to store the outcome of such analysis. Though the choice for registering simple and complex linguistic forms seems to be a longer and more complicated approach, it is also a more rewarding, because the outcome of the analyses can be used in making further calculations. In doing so, an iterative process is created by which the computer programs learn progressively more about the grammatical rules in Biblical Hebrew by means of pattern recognition. That means that the creation of the database itself leads to an increasing knowledge about Hebrew grammar and syntax.

When analyzing the Hebrew text of the *BHS*, the linguistic features of the text in its present form are described. Even in those cases where the Masoretic Text is unclear or may be assumed to be wrong, the features of the text as it stands are registered. In order to conduct corpus-linguistic research on the Hebrew text of the Old Testament, it is not necessary first to establish a text that is linguistically fully correct. The purpose of the WIVU is to make a text database that is searchable, so that it can be used both for discovering linguistic regularities and for tracing exceptions to these rules within the Masoretic Text.

The WIVU database is meant to be helpful to various groups of users. First, it can be used by Semitists for developing and testing linguistic theories, especially in relation to Classical Hebrew. Furthermore, it can help Bible translators in rendering similar syntactic constructions in the same way, because it provides insight into the patterns of elements in the Hebrew text. Finally, the WIVU database provides an instrument for biblical exegetes to examine grammatical, syntactic, and text-syntactic constructions in the Old Testament, in order to arrive at a better understanding of the text.

3. Building up the WIVU Database (1977–1987)

The first ten years of the WIVU were used to create a morphologically encoded database of the Old Testament and to develop programs for analyzing the linguistic features of the biblical texts. In order to build up the text database, it was necessary to make all kinds of decisions concerning the structure of the database and the storage of linguistic information. The present article will not discuss at length the founding years of the WIVU, because these have already

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[4] An exhaustive description of the categories used in the WIVU database is found in: E. Talstra, C.J. Sikkel, 'Genese und Kategorienentwicklung der WIVU Datenbank: Oder: ein Versuch, dem Computer Hebräisch beizubringen', in: C.F. Hardmeier e.a. (eds), Ad Fontes! Quellen erfassen – lesen – deuten. Was ist Computerphilologie? Ansatzpunkte und Methodologie – Instrumente und Praxis (Applicatio 15), Amsterdam 2000, 33-68.

been described in two contributions.[5] In this paper, we will only touch upon the most important developments in the first decade of the WIVU.

When the WIVU started it was the era of mainframe computers with punch cards and computer tape for storage. After several years the punch card machines were replaced by display terminals which were connected to two Cyber mainframe computers. In the late 1980s, a PC-network became available, which was used for teaching and text processing purposes; however, due to the more limited capacities of PCs at that time the WIVU continued to make use of the mainframe computers for its research until the early 1990s.

Like comparable computer projects, the WIVU started with imitating existing tools, such as classified bibliographies, concordances, and word indices. In order to demonstrate the results of computer-assisted research, the members of the WIVU published various classified bibliographies and concordances of particular biblical books. Especially worth mentioning are the concordances of Exodus and of Isaiah 40–55 and 56–66 produced for exegetical research in cooperation with other biblical scholars in the Netherlands and Belgium.[6] Those concordances not only contain a survey of all lexemes, with their frequency, reference, and context, but also offer illustrations of the possibilities a text database has for grammatical, syntactic, and literary study of the Bible.

Besides the cooperation with Dutch speaking scholars, the WIVU participated in the *Association Internationale Bible et Informatique* (AIBI), an international platform for scholars interested in the automated processing of biblical texts. The aim of the AIBI was to promote the use of computerized tools for text processing and publishing in biblical studies and to stimulate the exchange of methods and results between the various research groups. After the first AIBI meeting in Louvain-la-Neuve in September 1985, AIBI conferences continued to be held every three years at various places.[7]

In November 1987, the WIVU celebrated its tenth anniversary with an international symposium at VU University Amsterdam. In the opening address, Talstra noted that computer applications in biblical research started because one intended to produce new tools. The main purpose was to improve the existing tools, so that biblical scholars had better instruments for doing their exegetical work. According to Talstra, the WIVU database was meant not only to produce better tools, but also to reconsider the existing methods of exegesis:

> In addition, not contrary, to these existing approaches, the work of our Werkgroep from the very beginning has been somewhat more analytical, a little more concerned with the methodology involved in reading and analyzing biblical texts with the help of only formally defined tools.[8]

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[5] For the research conducted by the WIVU in the first ten years, see: E. Talstra, F. Postma, 'OTIK – Old Testament in the Computer', in: Hughes (ed.), *Bits, Bytes, and Biblical Studies*, 505-9. An extended version of that report appeared in 1989: idem, 'On Text and Tools: A Short History of the "Werkgroep Informatica" (1977–1987)', in: E. Talstra (ed.), *Computer Assisted Analysis of Biblical Texts: Papers Read at the Workshop on the Occasion of the Tenth Anniversary of the "Werkgroep Informatica" Faculty of Theology Vrije Universiteit, Amsterdam, November, 5-6, 1987* (Applicatio 7), Amsterdam 1989, 9-27.

[6] E. Talstra *e.a.*, *Deuterojesaja: Proeve van automatische tekstverwerking ten dienste van de exegese*, Amsterdam [1]1980; [2]1981; F. Postma *e.a.*, *Exodus: Materials in Automatic Text Processing,* part 1: Morphological, Syntactical and Literary Case Studies, part 2: Concordance, Amsterdam/Turnhout 1983; J. Bastiaens *e.a.*, *Trito-Isaiah: An Exhaustive Concordance of Isa. 56–66, especially with Reference to Deutero-Isaiah: An Example of Computer-Assisted Research* (Applicatio 4), Amsterdam 1984.

[7] Cf. R.-F. Poswick, 'From Louvain-la-Neuve (1985) to El Escorial in Madrid (2008): 25 Years of AIBI' in: L. Vegas Montaner *e.a.* (eds), *Computer Assisted Research on the Bible in the 21st Century* (Bible in Technology 5), Piscataway 2010, 3-23.

[8] E. Talstra, 'Introduction: Opening Address and Report', in: Talstra (ed.), *Computer Assisted Analysis of Biblical Texts*, 1-8 (2).

In the same month, Talstra defended his doctoral dissertation, written under the supervision of Professor M.J. Mulder, at Leiden University.[9] In his thesis, he discusses the complementarity of synchronic and diachronic examination of the Hebrew text illustrated on the basis of 1 Kings 8:14-61. Talstra comes to the conclusion that the two approaches can be considered to be complementary, if applied in the right order: first the synchronic analysis of the text, then the diachronic. Giving the synchronic examination priority over the diachronic examination has the advantage that it leaves more room for studying the language of the biblical text as a subject of its own. The linguistic and literary features of the text in its final form can be analyzed to some degree independently of assumptions concerning the historical background or the development of the text. On basis of the linguistic and literary analyses, the literary unity of the current composition can be described. In addition, the synchronic analysis will reveal shifts of idiom and unexpected changes in the text. The questions raised by the synchronic examination concerning the development of the text are to be answered by the diachronic examination.

Talstra's emphasis on the analysis of the linguistic and literary features of the biblical text in its present form is in line with his work on the WIVU database. The interpretation of the biblical text should be based as much as possible on the available textual data and not on assumptions concerning the historical background or the development of the text.

4. Publishing the WIVU Database (1988–1999)

The WIVU database became available for a broader public in the early 1990s. This goal was reached in collaboration with the Netherlands Bible Society (NBG) in Haarlem, AND software in Rotterdam, the Kirchliche Hochschule Bethel in Bielefeld, and Westminster Theological Seminary in Philadelphia. This collaboration made it possible to develop the program *Quest* containing a database of the Hebrew Bible plus retrieval software.[10]

Quest is a MS-DOS based program. It has a user interface which enables the user to write queries to search through the WIVU database. In addition, *Quest* contains a tool called Menu Query Language (MQL). In this tool, the user is recursively given choices about the specific layout of his query. This tool was meant to help a user write a syntactically correct query.[11] After running the query, the results appeared on the screen in Hebrew font in a list of individual references or in the context of their occurrence in the Hebrew text. Due to collaboration with the Westminster Theological Seminary, which developed a digital representation of the Leningrad Codex in the 1980s, it was possible to view the output in the context of the *BHS*.[12] The advantage of using the Westminster Leningrad Codex in *Quest* was that exegetes could view the results of their queries in the context of the Hebrew text they were familiar with.

The collaboration between the NBG and the WIVU was strengthened by the establishment of a special chair on Bible Translation at VU University Amsterdam sponsored by the NBG. As a result, the corpus-linguistic research of the WIVU was directly linked to the

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[9] E. Talstra, *Het gebed van Salomo: Synchronie en Diachronie in de kompositie van I Kon. 8,14-61*, Amsterdam 1987. An English translation appeared in 1993: idem, *Solomon's Prayer: Synchrony and Diachrony in the Composition of 1 Kings 8,14-61* (CBET 3), Kampen 1993. In 1995, Talstra was awarded the Professor Willem Mallinckrodt price by Groningen University for the best theological dissertation written between 1985 and 1995.

[10] E. Talstra *e.a.*, *Quest: Electronic Concordance Application for the Hebrew Bible*, Haarlem 1992.

[11] Cf. C.-J. Doedens, *Text Databases: One Database Model and Several Retrieval Languages* (Language and Computers 14), Amsterdam/Atlanta 1994, 244-5.

[12] Alan Groves of Westminster Theological Seminary joined the team of the WIVU in 1988. For many years he participated in the work of the WIVU, until his untimely death in February 2007. The work on the Westminster Leningrad Codex is maintained in the J. Alan Groves Center: http://grovescenter.org/.

education and training of Bible translators in the Netherlands.[13] The first extraordinary professor of Bible Translation was Jan de Waard (1988–1996). He was succeeded by Lourens de Vries as ordinary professor of Bible Translation in 1997. The master program in Bible translation is aimed at training students in biblical languages, general linguistics, information technology, theology, translation studies, and anthropology. One of the options is to take courses in the computer-assisted analysis of Old Testament texts and to get acquainted with the work of the WIVU. Some students of Bible translation became so enthusiastic about the possibilities of the WIVU database that they decided to continue their study and to write a doctoral dissertation on the benefit of using the database has for interpreting and translating the Hebrew text of the Old Testament.

The establishment of the chair of Bible Translation provided a platform for combining theoretical linguistic insights with the data-oriented approach of the WIVU. Linguists could use the WIVU database for developing and testing their theories, especially in relation to Classical Hebrew. The members of the WIVU, on the other hand, could use general linguistic insights for reflecting on the categories and the structure of the database in order to exploit its potential for further research goals and to interact with other approaches and theories. That the combination of the two disciplines is fruitful was demonstrated by Janet Dyk in her doctoral dissertation on the functioning of the Hebrew participle.[14] By applying insights from the Government and Binding theory of syntax, she shows that it is possible to analyze all of the structures in which participles occur in the Hebrew Bible within one system of syntactic rules.

In November 1991, Talstra was appointed extraordinary professor of 'Biblical Studies and Alpha Informatica especially the computer-driven text analysis' at the Faculty of Theology of VU University Amsterdam. He delivered his inaugural lecture in June 1992, a few weeks before the official presentation of the program *Quest* at the NBG office in Haarlem. In his inaugural lecture, Talstra emphasized that the combination of computers and biblical texts does not create a new discipline, but changes the order of exegetical methods.[15] The use of computers offers the possibility of arguing more systematically and independently on the basis of the language. Thus, the formal aspects of the biblical language are given priority over literary arguments or assumptions concerning the historical background or the development of the text. Though Talstra admits that it is unclear how far we can go with formal text analysis, he demonstrates that this is the route to be followed.[16]

After finishing the work on the textual data for *Quest*, the WIVU obtained its own UNIX computer network. The installation of the network was an important impetus for a thorough revision of the morphological encoding of the WIVU database. The outcome of this revision has been described by Arian Verheij in *Grammatica Digitalis I*.[17] Verheij gives a full description

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[13] In addition, Talstra was also personally involved in Bible translation. He participated as exegetical advisor in the development of the *Startbijbel* (1994), a simple translation of large portions of the Bible for children between the ages of 10 to 12. For all his activities in the field of Bible translation, Talstra was appointed an honorary member of the NBG in June 2013.

[14] J.W. Dyk, *Participles in Context: A Computer-Assisted Study of Old Testament Hebrew* (Applicatio 12), Amsterdam 1994.

[15] E. Talstra, *Schermen met Schrift: De kombinatie van bijbelwetenschappen en computer geïllustreerd aan de tekst van Genesis 48*, Amsterdam 1992, 1.

[16] Several PhD candidates used the WIVU database to demonstrate how the formal text analysis can contribute to the exegetical discussion. For example, A.L.H.M. van Wieringen, *Analogies in Isaiah,* vol. 1: Computerized Analysis of Parallel Texts between Isaiah 56–66 and Isaiah 40–66, vol. 2: Computerized Concordance of Analogies between Isaiah 56–66 and Isaiah 40–66 (Applicatio 10), Amsterdam 1993; T.L. Walton, *Experimenting with Qohelet: A Text-Linguistic Approach to Reading Qohelet as Discourse* (Amsterdamse Cahiers voor Exegese van de Bijbel en zijn Tradities Supplement Series 5), Maastricht 2006.

[17] A.J.C. Verheij, *Grammatica Digitalis I: The Morphological Code in the "Werkgroep Informatica" Computer Text of the Hebrew Bible* (Applicatio 11), Amsterdam 1994. Though there were plans to publish sequels to this study, as the title suggests, further volumes have not yet appeared.

of the morphological code of the database by presenting all the symbols used in the electronic text and explaining their meaning. Though in the course of time some adaptations of the morphological code have been made, the study of Verheij still serves as an introduction for those interested in the morphologically encoded text of the WIVU database. Another advantage of having the UNIX network was that it could be used for hands-on classes, so that master and doctoral students could work with the programs developed by the WIVU. In doing so, they learned in an interactive way the effects of the choices made in syntactic analysis.

In August 1994, the fourth international conference on Bible and Computers was held in Amsterdam and organized by the WIVU with support of the NBG. The theme of the fourth AIBI meeting was: 'Desk and Disciple: The Impact of Computers on Biblical Studies'. The guiding question of the conference was:

> Is the machine, strictly speaking, only organizing our *desk*, or is it also capable of organizing our *discipline*? In other words, does the computer help us at our desk by replacing our books (dictionaries, text editions) and files (notes on cards), or does the computer also rearrange our discipline by changing or making explicit the order and the type of our linguistic and literary argumentation?[18]

In the program of the fourth AIBI conference the close relation between the use of the computer and the methodological consequences clearly shows that the WIVU was involved in the organization.

Another illustration of the international contacts of the WIVU was the growing number of doctoral students from abroad. Especially worth mentioning are the three PhD candidates of Lund University. The subjects of their dissertations show that the WIVU database is used by biblical scholars with different interests: some use it to examine the relation between linguistic structure and literary strategy (Cheney), others focus on the connection between corpus-linguistic research and general linguistics (Winther-Nielsen), while others use it for analyzing Hebrew grammar, especially the Biblical Hebrew verbal system (Ljungberg).[19]

Finally, the international orientation of the WIVU can be illustrated by the collaboration of the WIVU with the German Bible Society (DBG) in Stuttgart, the University of Greifswald, and Westminster Theological Seminary in Philadelphia in developing a successor to the program *Quest*. In November 1998, a conference on 'Computer philology' was held in Greifswald.[20] One of the papers was the lecture by Wolf-Dieter Syring, in which he discusses the development of the program *Quest* 2.[21] Unlike its precursor *Quest* 1, *Quest* 2 was planned to be a Windows-based program. Furthermore, it would contain not only an extended version of the WIVU database but also the text-critical apparatus of the *BHS*, a Hebrew lexicon, some ancient versions, and various modern translations. By adding various tools to the biblical text, *Quest* 2 was intended to be used as a study Bible by a broad public. Unfortunately, the

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[18] Cf. E. Talstra, 'Desk and Discipline: The Impact of Computers on Biblical Studies', in: *Proceedings of the Fourth International Colloquium Bible and Computer: Desk and Discipline: The Impact of Computers on Biblical Studies, Amsterdam, 15-18 August 1994*, Paris/Geneva 1995, 25-43 (27).

[19] M.S. Cheney, *Dust, Wind and Agony: Character, Speech, and Genre in Job* (CBOT 36), Stockholm 1994; N. Winther-Nielsen, *A Functional Discourse Grammar of Joshua: A Computer-Assisted Rhetorical Structure Analysis* (CBOT 40), Stockholm 1995; B.-K. Ljungberg, *Verbal Meaning: A Linguistic, Literary, and Theological Framework for Interpretive Categories of the Biblical Hebrew Verbal System as Elaborated in the Book of Ruth*, Lund 2001.

[20] The contributions to the conference were published in: C.F. Hardmeier *e.a.* (eds), *Ad Fontes! Quellen erfassen – lesen – deuten: Was ist Computerphilologie? Ansatzpunkte und Methodologie – Instrumente und Praxis* (Applicatio 15), Amsterdam 2000.

[21] W.-D. Syring, 'Nutzung grammatischer Textdatenbanken zur Analyse literarischer Texte mit Quest 2', in: Hardmeier *e.a.* (eds), *Ad Fontes!*, 159-70; see also: idem, 'Quest 2 – Computergestützte Philologie und Exegese', *ZAH* 11 (1998), 85-9.

development of the software for *Quest* 2 ran into serious problems. As a consequence, the program *Quest* 2 did not get further than a test version and was never officially published.

5. Expanding the WIVU Database (2000–2009)

An important development in the late 1990s was the cooperation between the WIVU and the Peshiṭta Institute Leiden (PIL).[22] The two research groups joined forces in the project *Computer-Assisted Linguistic Analysis of the Peshiṭta* (*CALAP*) (1999–2004), funded by the Netherlands Organisation for Scientific Research (NWO). The goal of this project was to extend the computer-assisted analysis to the Peshiṭta, an ancient version of the Old and New Testaments in Syriac. The Old Testament of the Peshiṭta was probably translated from Hebrew into Syriac in the 2nd century CE. By extending the WIVU model to the Peshiṭta, it became possible to analyze Syriac texts by the same method. Furthermore, it opened the door to compare the Syriac text of the Peshiṭta with the Hebrew text of the Masoretic tradition. The main focus of the *CALAP* project was the comparison of the Syriac translation of 1–2 Kings in the Peshiṭta with the Hebrew text of the two biblical books in the Masoretic tradition.[23] In addition, the CALAP model was used for analyzing the Syriac version of Ben Sira and for comparing the Syriac poetry of Ben Sira with the Syriac prose of Kings.[24]

The comparison of the Syriac and the Hebrew texts of 1–2 Kings provided the basis for discussing the relation between a text-critical and text-historical diachronic analysis of the Hebrew Bible and the Peshiṭta, on the one hand, and a synchronic linguistic and literary analysis on the other. In the interaction between the two disciplines, the priority of one discipline over the other plays an important role.

> One could say that corpus linguistics can only start if the corpus to be investigated and its status from a text-historical perspective has been established …. However, if it is acknowledged that linguistic phenomena belong to the essential characteristics of a text, then corpus linguistics is also an instrument for textual criticism.[25]

One of the conclusions of the *CALAP* project was that both linguistic analysis and text-critical investigation are of value and have their own contribution. To cope with the complexity of biblical texts, it is necessary to start with both disciplines. The rich field of research into ancient versions of the Hebrew Bible and their contribution to our understanding of the text was embarked upon.

The collaboration between the WIVU and the PIL was continued in the project *Turgama: Computer-Assisted Analysis of the Peshiṭta and the Targum: Text, Language and Interpretation* (2005–2010), again financed by NWO. In that project under supervision of Wido van Peursen, the *CALAP* model was applied to other books of the Peshiṭta (Judges, Psalms,

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[22] The PIL was founded in 1959 when the Leiden Professor P.A.H. de Boer was appointed as chief editor of the new critical edition of the Old Testament Peshiṭta. Due to the termination of biblical studies at Leiden University, the institute moved to VU University Amsterdam in 2014.

[23] The results were published in: J.W. Dyk, P.S.F. van Keulen, *Language System, Translation Technique, and Textual Tradition in the Peshiṭta of Kings* (Monographs of the Peshiṭta Institute Leiden 19), Leiden 2013.

[24] The results appeared in: W.Th. van Peursen, *Language and Interpretation in the Syriac Text of Ben Sira: A Comparative Linguistic and Literary Study* (Monographs of the Peshiṭta Institute Leiden 16), Leiden 2007.

[25] Cf. K.D. Jenner *e.a.*, 'CALAP: An Interdisciplinary Debate between Textual Criticism, Textual History and Computer-Assisted Linguistic Analysis', in P.S.F. van Keulen, W.Th. van Peursen (eds), *Corpus Linguistics and Textual History: A Computer-Assisted Interdisciplinary Approach to the Peshiṭta* (SSN 48), Assen 2006, 13-44 (41).

Epistle of Baruch, Prayer of Manasseh),[26] to the book of Judges in the Aramaic version, the Targum, and to a non-biblical text originally written in Syriac.[27]

In 2002, Talstra succeeded Henk Leene as professor of Old Testament at VU University Amsterdam. Leene had held the ordinary chair of Old Testament and Talstra the extraordinary chair of Alpha Informatica, but with the new appointment, Talstra combined the two. His appointment was as professor of Old Testament 'with special attention to the application of information technology'.[28] In the same year, Talstra published a study on methods of exegesis in which he calls attention to the relation between various exegetical methods. In his view, both classic and modern approaches can contribute to the exegesis of biblical texts, when applied in the right order.[29] The analysis of the language of the text should precede the analysis of the literary composition. Furthermore, the analysis of the text in its final form should have priority over the examination of the development of the text. Finally, questions concerning the interpretation of the text by former readers should precede questions concerning the interpretation of the text by current readers. Talstra's arrangement of the exegetical methods shows that he considers linguistic analysis of the biblical text to be the first task of an exegete. This conclusion concurs with his efforts to build up a database of the Old Testament which provides an exegete with an instrument to analyze the linguistic patterns independently to some degree of the literary composition and the historical background of the text.

Another important step forward was the publication of the *Stuttgart Electronic Study Bible* (*SESB*).[30] After the unsuccessful attempts to develop *Quest* 2, the DBG decided to cooperate with Logos Bible Software in Seattle to produce a study Bible that not only contained resources for studying the Bible but also provided access to the WIVU database of the Old Testament. *SESB* is published by the DBG and the NBG, while the software and the graphical user interface were developed by Logos Bible Software. Unlike its precursor *Quest* 1, *SESB* is a Windows-based program, which is more user friendly. Instead of writing queries, a user could click on the icons representing linguistic and literary features. After the publication of the first edition in 2004, a slightly revised edition of *SESB* appeared in 2006.

Though the linguistic information added to the WIVU database increased through the years, the first two editions of *SESB* did not contain versions of the database that provided a fully analyzed text of the complete Hebrew Bible. While the database in *Quest* 1 provided an analyzed text of the complete Hebrew Bible at word level and a fully analyzed text of about 10 percent of the biblical text, the versions of the database in the first two editions of *SESB* provided a fully analyzed text of about 50 percent of the Hebrew Bible. Most narrative books (e.g., Genesis) were prepared up through the level of clause hierarchy, while many prophetic and poetic books (e.g., Isaiah, Psalms) were only partly analyzed above phrase level.[31]

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[26] Cf. A. Gutman, W.Th. van Peursen, *The Two Syriac Versions of the Prayer of Manasseh* (Gorgias Eastern Christian Studies 30), Piscataway 2011.

[27] In his doctoral dissertation, Dirk Bakker used the *CALAP* model for the analyzing the Syriac text of a manuscript of the 7th century of the *Book of the Laws of the Countries*. See D. Bakker, *Bardaisan's Book of the Laws of the Countries: A Computer-Assisted Linguistic Analysis*, Leiden 2011. By applying the model to a non-biblical text originally written in Syriac, it became possible to compare the linguistic features of Syriac versions of biblical texts with those of an original Syriac text.

[28] Talstra explicitly mentioned the addition in his inaugural lecture delivered in March 2003: E. Talstra, *"Zou er ook wetenschap zijn bij de Allerhoogste?" (Psalm 73:11)*, Amsterdam 2003, 28.

[29] Cf. E. Talstra, *Oude en nieuwe lezers: Een inleiding in de methoden van uitleg van het Oude Testament* (Ontwerpen 2), Kampen 2002, 112-7; cf. also: idem, 'From the "Eclipse" to the "Art" of Biblical Narrative: Reflections on Methods of Biblical Exegesis', in: E. Noort (ed.), *Perspectives on the Study of the Old Testament and Early Judaism: A Symposium in Honour of Adam S. van der Woude on the Occasion of His 70th Birthday* (VT.S 73), Leiden 1998, 1-41 (13-6).

[30] C.F. Hardmeier *e.a.* (eds), *Stuttgarter Elektronische Studienbibel*, Stuttgart/Haarlem ^{1}2004; ^{2}2006; ^{3}2009.

[31] Rightly noted by A.J.C. Verheij in his review of the first edition of *SESB*, 'De Stuttgarter Elektronische Studiebijbel (SESB): Een kennismaking', *Met Andere Woorden* 24/1 (2005), 37-43 (41).

Thus far, the WIVU had mainly concentrated on the analysis of narrative texts and the poetic and prophetic texts had received less attention. As a step forward, the WIVU embarked on a new project, *Linguistic System and Literary Design: Computer-Assisted Analysis of Non-narrative Texts of the Hebrew Bible* (2005–2009), financed by NWO. The first goal of this project was to prepare a fully analyzed text of the prophetic books of Isaiah and Jeremiah and the poetic book of the Psalms to be added to the third edition of *SESB*.[32]

The second goal of the project was to examine the syntax of prophetic and poetic texts more closely. Unlike narrative texts, prophetic and poetic texts frequently make use of literary devices, such as parallelism, chiasmus, inclusion, and acrostics. In addition, they often use compact language, with unexpected shifts in person, number, and with participants that are not or not fully identified. Because in the first years the WIVU had concentrated on the analysis of narrative texts, the programs designed for the analysis of the higher levels of the text mainly rely on the syntactic structures employed in narrative texts. When using the same techniques for analyzing poetic and prophetic texts, the procedures bring to light the similarities and differences between the syntactic structures used in narrative texts and in prophetic and poetic texts.

Though it is to be expected that the Hebrew grammar of prophetic and poetic texts makes a different use of the language system than do narrative texts, there are still syntactic patterns to be found in those texts. For that reason, attention must be paid not only to the literary presentation of the text, but also to the underlying linguistic system.[33] Only in doing so, the cooperation of linguistic rules and literary devices in prophetic and poetic texts can be rightly understood.

6. Exploiting the WIVU Database (2010–present)

After the publication of the third edition of *SESB* in 2009, the WIVU looked for new ways to contribute to Old Testament exegesis and teaching. In a new project, *Bridging Data and Tradition: The Hebrew Bible as a Linguistic Corpus and as a Literary Composition* (2010–2014, again funded by NWO, the WIVU sought to connect computational linguistic analysis and philological research of the Hebrew Bible. There were two main foci in trying to bridge the gap between linguistic data and the tradition of interpretation.

The first purpose was to further enrich the database with information on the verbal valence patterns and the identification of participants. Valence is the ability of a verb to combine with other sentence constituents in specific patterns. Insight into the different combinations of elements occurring with the same verb helps to recognize the particular meaning of a verb in a given instance.[34] Identification of participants has to do with whether the identity of personages in the text can be traced, despite shifts in person, gender, and number and despite gaps in information. With the help of a computer, one can calculate whether a marker of a participant in the text most probably refers to one personage or the other.[35] The second purpose was to

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[32] The third edition of *SESB*, which appeared in 2009, contains a version of the database that was expanded with a fully analyzed text of several biblical books, including the prophetic books of Isaiah and Jeremiah.

[33] The analyses of Jeremiah and Isaiah provided the basis for the doctoral dissertations of O. Glanz, *Understanding Participant-Reference Shifts in the Book of Jeremiah: A Study of Exegetical Method and Its Consequences for the Interpretation of Referential Incoherence* (SSN 60), Leiden 2013; and R.H. Oosting, *The Role of Zion/Jerusalem in Isaiah 40–55: A Corpus-Linguistic Approach* (SSN 59), Leiden 2013.

[34] Cf. J.W. Dyk *e.a.*, 'Analysing Valence Patterns in Biblical Hebrew: Theoretical Questions and Analytical Frameworks', *JNSL* 40/1 (2014), 43-62.

[35] Cf. E. Talstra, 'The Bible as Data and as Literature: The Example of Exod 16', in: H. Ausloos, B. Lemmelijn (eds), *A Pillar of Cloud to Guide: Text-Critical, Redactional, and Linguistic Perspectives on the Old Testament in Honour of Marc Vervenne* (BETL 269), Leuven 2014, 549-67.

develop instruments which would allow the WIVU database to be used by a broader group of researchers and teachers. The latter is done in cooperation with other research groups, such as the team of Nicolai Winther-Nielsen in developing the *PLOTlearner*, a computer program for learning Biblical Hebrew, available to students worldwide.[36]

The collaboration with the Data Archiving and Networked Services (DANS), an institute the Royal Netherlands Academy of Arts and Sciences (KNAW) and NWO, brought the database into a broader playing field. From 2008 onwards, DANS has hosted a website containing a query interface to the WIVU database of the Old Testament. The aim of the website is to give researchers the opportunity of searching the database, and to provide a platform for sharing interesting queries.

In cooperation with DANS and New Testament scholars, the WIVU organized an international workshop on Biblical Scholarship and Humanities Computing at the Lorentz Center in Leiden in February 2012. The guiding question of the conference was: How can we analyze, store, and retrieve linguistic data at the level of syntax and discourse, especially when we know that texts have been reworked and updated during the long period of their transmission? The theme of the workshop at the Lorentz Center nicely illustrates the relevance of the work of the WIVU in the field of Digital Humanities.[37] Though the Hebrew Bible is not a big corpus—the WIVU database consists of approximately 426,000 individual words—it is a unique literary artifact produced by scribes and copyists before the art of printing was invented. As a consequence, it cannot be analyzed in the same way as writings produced after the invention of printing, but requires an approach that integrates general models of human cognition with the process of specific changes through history.[38]

In August 2011, Talstra retired as professor of Old Testament, but has remained involved in the work of the WIVU.[39] Talstra was succeeded by Wido van Peursen as professor of Old Testament and head of the WIVU. Due to his involvement in the projects *CALAP*, *Turgama*, and *Bridging Data and Tradition*, Van Peursen was acquainted with the research of the WIVU. At Van Peursen's inaugural address in May 2013, the WIVU was renamed the Eep Talstra Centre for Bible and Computer (ETCBC).[40]

The current ETCBC database contains a morphologically fully analyzed text of the complete Hebrew Bible; the analysis of all levels up through text hierarchy will soon be complete. Though the syntactic analysis is almost finished, there remains much to do. In the course of time new insights into Hebrew grammar and syntax have developed. Those insights, however, have not all as yet been incorporated in the database. Furthermore, the ETCBC's aim is to make the analysis of the data more consistent. Through the years, the various people working on the database did not always make the same choices. When looking more closely at

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[36]The *PLOTLearner* can be downloaded for free from: http://eplot.3bmoodle.dk/.

[37] The growing interest of computer linguists in biblical texts was already visible in the preceding years. Talstra and Van Peursen were involved in the KNAW Colloquium on E-Philology in October 2008, and Talstra was president of the Scientific Advisory Board of the *Virtual Knowledge Studio for the Humanities and Social Sciences* (http://virtualknowledgestudio.nl/) from 2006 to 2010. For an elaborated view on the collaboration between biblical scholars and computer linguists, see Eep Talstra's contribution to the present volume.

[38] E. Talstra, 'In the Beginning, when Making Copies Used to be an Art … : The Bible among Poets and Engineers', in: W.Th. van Peursen *e.a.* (eds), *Text Comparison and Digital Creativity: The Production of Presence and Meaning in Digital Text Scholarship,* Leiden 2010, 31-56 (54); idem, 'The Hebrew Bible and the Computer: The Poet and the Engineer in Dialogue', *International Journal of Humanities and Arts Computing* 1 (2007), 49-59.

[39] At his farewell in October 2011, Talstra received a *Festschrift* edited by W.Th. van Peursen and J.W. Dyk, *Tradition and Innovation in Biblical Interpretation: Studies Presented to Professor Eep Talstra on the Occasion of his Sixty-Fifth Birthday* (SSN 57), Leiden 2011. This study contains an overview of all doctoral dissertations written under his guidance (461-3), and an overview of his publications up to 2011 (465-82).

[40] Cf. W.Th. van Peursen, *Grip op grillige gegevens: De exegeet als systematicus*, Amsterdam 2013, 15. The current web address of the ETCBC is: http://godgeleerdheid.vu.nl/nl/onderzoek/instituten-en-centra/eep-talstra-centre-for-bible-and-computer/.

the inconsistencies in the database, it is to be expected that new insights into Hebrew grammar and syntax will appear. The cases in which analysts preferred different options are usually the most interesting ones. Finally, the ETCBC is still working on possibilities to enrich the ETCBC database with information about verbal valence patterns, clause connections, and the identification of participants. The development of functional labels for the various clause connections is relevant for research into the structure of both narrative and poetic texts,[41] but it also helps Bible translators render similar constructions consistently. As a result, the rendering of conjunctions, verbal tenses, and verbal valence patterns in Bible translations will be less *ad hoc* and more based on comparable constructions in the Hebrew Bible.

Recently, the collaboration of DANS and the ETCBC is developing a successor to the website hosted by DANS containing a query interface to the ETCBC database. In order to improve the opportunities for researchers to search the database and to share interesting queries via the internet, DANS and the ETCBC joined forces in the project *System for Hebrew Text: Annotations for Queries and Markup* (SHEBANQ) (2013–2014), funded by CLARIN-NL.[42] The aim of the project is not only to enable students, teachers, and researchers to perform advanced searches on the database, but also to save and publish significant results as annotations to this resource. After the first release of the website in July 2014, Dirk Roorda and others are looking for opportunities to improve and enrich the utility of the website.[43]

Besides working on the consistency and the accessibility of the database, the ETCBC also aims at expanding the database with other texts. Within the framework of the project *Does Syntactic Variation reflect Language Change? Tracing Syntactic Diversity in Biblical Hebrew Texts* (2013–2017), funded by NWO, under supervision of Dyk and Van Peursen, the ETCBC database is being expanded with ancient inscriptions, Dead Sea manuscripts, and Rabbinic texts in both Hebrew and Aramaic. The purpose of the project is to chart a broad spectrum of syntactic constructions in specified syntactic environments throughout biblical and non-biblical texts in order to document linguistic variation. By analyzing syntactic contexts in which a textual variant occurs and by implementing general linguistic insights into language variation and change, the project seeks to bring to light whether the texts show a random use of multiple variants or whether a shift and development in the use of the possibilities can be traced.

Finally, the ETCBC works together with various research groups in the field of Digital Humanities. The approach of the ETCBC fits well into the increasing use of computer-assisted research in Humanities to uncover patterns, structures, and mechanisms that are present in human artifacts. It is not without reason that in his inaugural address Rens Bod mentioned Talstra as one of the pioneers of Digital Humanities: 'The Netherlands played a pioneering role in digital theology, specifically in the computer-assisted study of the Old Testament (Eep Talstra)'.[44]

The database model developed by the ETCBC can be applied both to biblical and non-biblical texts and to other languages besides Hebrew. The model is particularly helpful for examining textual corpora of manually copied manuscripts. Due to complex process of their reworking and transmission, those texts cannot be analyzed in the same way as writings produced after the invention of printing. Recently, a first step has been made in extending the ETCBC model to Syriac manuscripts from the 2nd and 4th century CE by analyzing and comparing texts of Bardaisan of Edessa and Ephrem the Syrian. Though there has thus far been

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[41] Cf. G.J. Kalkman, *Verbal Forms in Biblical Hebrew Poetry: Poetical Freedom or Linguistic System?*, Amsterdam (to appear in 2015).

[42] CLARIN-NL stands for Common Language Resources and Technology Infrastructure in the Netherlands.

[43] The web address of the SHEBANQ project is: http://shebanq.ancient-data.org/.

[44] R. Bod, *Het Einde van de Geesteswetenschappen 1.0*, Amsterdam 2012, 11: 'Nederland had een voortrekkersrol in de digitale theologie, vooral in de computerondersteunde studie van het oude testament (Eep Talstra)'.

little funding for Greek projects, the ETCBC has developed a morphological coding system for Greek, which has been applied to a limited number of texts.[45]

7. Conclusions

When describing the history of the WIVU, it becomes clear that its database and its methodological line of thinking are closely related. This connection is already visible in its founding years (1977–1987). The work of the WIVU started in the 1970s of the previous century when various computer projects were initiated. In order to build up the textual database, it was necessary to make many of decisions concerning the structure of the database and the storage of linguistic information. Unlike other projects, the WIVU intended not only to imitate existing tools, but also to develop the methodology of reading and analyzing biblical texts. At its tenth anniversary, Talstra characterized the position of the WIVU as follows: 'the work of our Werkgroep from the very beginning has been somewhat more analytical, a little more concerned with the methodology in reading and analyzing biblical texts'.

The connection between the WIVU database and its methodology continued to be crucial in the period that the database was published (1988–1999). In his inaugural lecture, Talstra emphasized that the combination of computers and biblical texts does not create a new discipline. Yet, the computer-assisted analysis of biblical texts changes the order of exegetical methods. The use of computers offers the possibility of arguing more systematically and independently on the basis of the language. The publication of *Quest* 1 and its successor *SESB* opened up to exegetes, Bible translators, and Semitists the possibility of searching through the database for linguistic features. In doing so, they were able to give the formal aspects of the language of the biblical text priority over literary arguments or assumptions concerning the historical background or the development of the text.

The WIVU database was expanded during the years 2000–2009 through the systematic analysis of syntactic structures of non-narrative texts in the Hebrew Bible, and through the joint projects with the PIL in which the WIVU model was applied to Syriac texts, both biblical and non-biblical. In both cases the connection between the database and the methodology played an important role. The systematic analysis of linguistic patterns of poetic and prophetic texts concurs with Talstra's study on the methods of exegesis: the analysis of the biblical language of the text should precede the analysis of its literary composition. Furthermore, the linguistic analysis of Syriac texts and it comparison with the original Hebrew text shows that corpus linguistic research does not have to wait until the original text has been reconstructed, but rather that corpus linguistics can be used as a tool for textual criticism.

From 2010 onwards, the WIVU database, now named after its founder ETCBC database, is exploitable for further research and teaching. The SHEBANQ website opens up to students, teachers, and researchers worldwide the possibility of a more ready access to the database. As a result, it is easier to use the ETCBC database in classes, so that students can learn how to search for linguistic patterns in the Old Testament. Furthermore, the database is still being expanded with biblical and non-biblical texts in Hebrew, Aramaic, Syriac, and Greek. These expansions are not only preparation for research to be done, but are themselves part of the research itself. Finally, the database is being enriched with information on verbal valence, clause connections, and the identification of participants. That information is not only relevant for users of the database, but the examination of verbal valence, clause connections, and participants in the text will also provide new insights into Hebrew grammar and syntax.

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[45] In her PhD project on the Book of Esther, Staci King intends to incorporate the Alpha text of Esther and the Septuagint of Esther in order to treat text-historical questions in relation to the book.

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