

**American Sign Language
Linguistic Research Project**



**A Guide to the ASLLRP Sign Bank –
New Search Features**

**Carol Neidle
Augustine Opoku**

Boston University, Boston, MA

Report No. 25, American Sign Language Linguistic Research Project
<http://www.bu.edu/asllrp/>

© July 2024, Boston University

Available from: <http://www.bu.edu/asllrp/rpt25/asllrp25.pdf>

The ASLLRP Sign Bank allows browsing, search, and download of collections of signs and utterances.

1. DATA ACCESS INTERFACE: CONTINUOUS SIGNING DATA (UTTERANCES) -- <https://dai.cs.rutgers.edu/dai/s/dai>

Our high-quality videos (multiple views, including face close-ups) of linguistically annotated¹ ASL sentences can be searched and viewed in various ways. The **sign** search interface is shown in Figure 1, with example search results shown in Figure 2. Searches can also be conducted based on **utterance-level properties**, as shown in Figure 3 (which extends over pages 2 and 3). All of these searches can also be restricted by collection and/or signers (“participants”).

Figure 1. Sign Search - in SignStream® Collections

¹ Annotations were carried out using SignStream®, available free of charge from www.bu.edu/asllrp/SignStream/3 (Neidle 2017, 2018; Neidle, *et al.* 2018; Neidle 2020, 2022). More detailed information about annotation conventions is also available (Neidle 2002, 2007; Neidle, *et al.* 2012).

Partial Results of Search for Signs with Glosses Containing the Characters “stop”

Search - ASLLRP Linguistic Annotations and Video Files

stop

Whole Partial

Hand Dominant Non-Dominant Don't Care

Query Results: Sign Summary

[Expand all](#)

Sign	Occurrences	Ben	Cory	Jonathan	Rachel
(1h)STOP	1	1	0	0	0
STOP	11	1	1	1	8
STOPLIGHT	1	0	1	0	0

<input type="checkbox"/> Rachel_2012-02-14_sc63-U-9			<p>Gloss..</p> <p>Sign: </p> <p>Utterance: </p>	<p>topic/focus: <u>foc/adv</u></p> <p>dh: MAYBE TOMORROW RAIN FINISH STOP</p> <p>dh shape: </p> <p>ndh: MAYBE RAIN FINISH STOP</p> <p>ndh shape: </p> <p>engl trans: Maybe tomorrow it will stop raining.</p>
<input type="checkbox"/> Rachel_2012-02-14_sc63-U-10			<p>Gloss..</p> <p>Sign: </p> <p>Utterance: </p>	<p>cond/when: <u>cond</u></p> <p>dh: IF TOMORROW RAIN STOP IX-1p DEPART</p> <p>dh shape: </p> <p>ndh: RAIN STOP</p> <p>ndh shape: </p> <p>engl trans: If it stops raining tomorrow, I will leave.</p>
<input type="checkbox"/> Rachel_2012-02-09_sc61-U-30			<p>Gloss..</p> <p>Sign: </p> <p>Utterance: </p>	<p>cond/when: <u>cond</u></p> <p>dh: GO-OUT SNOW+ STOP SCHOOL FUTURE fs-RE +OPEN TOMORROW</p> <p>dh shape: </p> <p>ndh: SNOW+ STOP SCHOOL OPEN</p> <p>ndh shape: </p> <p>engl trans: If it stops snowing outside then school will reopen tomorrow.</p>
<input type="checkbox"/> Rachel_2012-02-09_sc60-U-5			<p>Gloss..</p> <p>Sign: </p> <p>Utterance: </p>	<p>negative: <u>neg</u></p> <p>dh: ns-fs-MARY NOT STOP ROWING #NO+</p> <p>dh shape: </p> <p>ndh: STOP ROWING</p> <p>ndh shape: </p> <p>engl trans: No, Mary didn't stop rowing.</p>

Sign video for Rachel_2012-02-09_sc60 U:5 Sign=stop View=Side

ASLLRP [0060] 00:00:18:25

0:00 / 0:00



Figure 2. Example of Sign Search Results – Multiple views of Signs and Utterances can be played.

ASLLRP Continuous Signing Corpora

Utterance Search

Q SUBMIT

Limit to (Limit the search results to the following options)

- + Grammatical Construction (3413)
 - negative (595)
 - wh question (328)
 - yes-no question (254)
 - + rhetorical question (274)
 - rhq (238) rhq2 (36)
 - + topic/focus (1370)
 - foc/prop-with-ref-to (23) sentence-initial adverb (156)
 - focus (245) topic (946)
 - + conditional/when (469)
 - conditional (300) when (169)
 - + role shift (79)
 - other (14) other (2) Deaf (12) other2 (1) mother (4) role shift other person (21) parents (1)
 - hearing person (3) CODA (1) narrator (4) proctor (2) student (2)
 - teacher (2) woman (2) hearing person (2) CODA (2) friend (2) narrator (1)
 - relative clause (44)

And (Combine grammatical construction or non-manual markings)

- + Non-manual Markings (32283)
 - + Head Position (9617)
 - + head_pos: tilt fr/bk (2839)
 - further back (69) front (653) back (645) slightly back (852) slightly front (557)
 - further front (63)
 - + head_pos: turn (2014)
 - left (440) right (448) slightly right (471) slightly left (581) further right (43)
 - further left (31)
 - + head_pos: tilt side (3238)
 - left (470) right (662) slightly right (1249) head dip left (2) slightly left (745)
 - further right (33) further left (77)
 - + head_pos: jut (1526)
 - slightly back (260) further back (13) forward (640) back (160) further forward (42)
 - slightly forward (411)
 - + Head Movement (2856)
 - + head_mvmt: nod (1085)
 - slight slow head nod (42) slight single head nod (129)
 - rapid (203) slow (136) single (305) slight rapid head nod (270)
 - + head_mvmt: nod cycles (1)
 - maximum (1)
 - + head_mvmt: shake (1204)
 - rapid (281) slow (233) single (170) slight rapid head shake (380) slight slow head shake (74)
 - slight single head shake (66)
 - + head_mvmt: side to side (63)
 - rapid (22) slow (25) single (16)
 - + head_mvmt: jut (503)
 - further forward (4) slightly forward (37)
 - slightly forward (13) slightly forward (2) slightly forward (1)
 - forward (251) back (56) slightly forward (18) slightly back (98)
 - left (4)
 - slightly forward (13) further back (3) further forward (1)
 - slightly forward (2)
 - + body lean (649)
 - back/left (50) back/right (53) slightly right (35) left (86) slightly left (1)
 - right (57) forward (92) slightly left (1) back (78) forward/right (19)
 - slightly forward (87) slightly right (4)
 - forward/left (25) slightly back (60) slightly left (1)

ABOUT THESE DATASETS

Q Sign Search

Q Utterance Search

Acknowledgments & Credits

Sign Bank

Statistics

(continued from previous page)

+shoulders (141)

- back/right (4) down (3) left/down (2) right/down (1) back/left (2)
- forward/left (2) raised (38) left/raised (6) right/raised (14)
- further raised (5) slightly raised (2) left (7) shrug (23) left/shrug (4)
- right/shrug (4) slightly raised (12) right (3) forward (2) Alternating Shoulder Movement (1)
- slightly left (1) slightly right (1) forward/right (4)

+ face (19020)

- + eye brows (4928)**
 - left raised/right lowered (3) raised (1527) lowered (888)
 - slightly lowered (646) left raised/right furrowed (2)
 - slightly raised (650) further lowered (289)
 - left raised/right furrowed (2) further raised (439)
 - raised-furrowed (2) raised-furrowed (437)
 - left raised/right furrowed (1)
 - right raised/left furrowed (25)
 - further raised-furrowed (1)
- + eye gaze (2095)**
 - other (435) up/left (46) to addressee (43) into space (251) up (48)
 - up/right (63) down/left (126) down (210) left (538) watch hands (106)
 - down/right (229)
- + eye aperture (9344)**
 - slightly lowered (620) further lowered (650)
 - slightly squinted (995) further squinted (561) wider (205)
 - slightly wide (813) blink (1765) squint (1311) wide (1022) lowered lid (1009)
 - closed (393)
- + nose (265)**
 - slightly wrinkled (1) wrinkle (106) slightly wrinkle (1)
 - tensed (100) slightly tensed (24) further tensed (3)
 - slightly wrinkled (3) wrinkle left (22) wrinkle right (5)
- + mouth (2285)**
 - puh (1) pow (2) cs (7) intense (100) open (41) tongue out (81) blow (37) sh (105)
 - lips spread (174) lips pursed: oo (180)
 - lips spread & crnrs up (87)
 - lips spread & crnrs down (245) left tense (5)
 - left tense (8) bite lower lip (102) tongue on lwr lip (38)
 - open & round (99) right tense (1) open & tense (65)
 - open & corners down (44) open & tongue visible (238)
 - brr (30) smile mouth open (96) lips pursed: oo-tight (60)
 - lips pursed corners down (58) right tense (108)
 - left tense (4) left tense (1) left tense (4)
 - lips pursed: mm (200) raised upper lip (21) left tense (2)
 - tongue sucked in quickly (6)
 - lips pursed corners down (2) left tense (1)
 - left tense (2) tongue mvmt lateral (7) left tense (5)
 - left tense (1) cha (6) left tense (5) left tense (5)
 - left tense (1)
- + cheeks (103)**
 - puffed (49) tensed (16) puff right (4) puff left (3) less tensed (3)
 - tensed right (16) tensed left (11) more tensed (1)

Search English Translation (Limit the search results to the following...)

Search English Translation..

Figure 3. Utterance Search Options

2. SIGN BANK: INDIVIDUAL SIGNS -- <https://dai.cs.rutgers.edu/dai/s/signbank>

It is also possible to browse, search, and download individual signs—both citation-form signs and signs pre-segmented, based on manual annotations carried out using SignStream® of start and end points of signs from our continuous signing videos. This search interface is shown in Figure 4.



Figure 4. Search Options for Individual Signs – both Citation-form Signs and Signs Pre-segmented from Continuous Signing

The display on the left is an alphabetical listing of unique gloss ID labels for signs in our collection, with similar lexical variants grouped under a main entry listing, e.g., for APPOINTMENT produced with different handshape configurations, where the main entry APPOINTMENT has entry/variants labelled as (A)APPOINTMENT (produced with the “A” handshape) and (nd-S)APPOINTMENT (produced with the “S” handshape on the non-dominant hand). It is possible to scroll through this list, or to click once in the list and start typing: the cursor will advance to the next occurrence of the typed sequence. It is also possible to search for text contained in the gloss labels or in related English words (this last feature is a new addition), and/or to specify start and/or end handshapes. It is also possible to display specific types of signs, as shown in the pull-down menu at the top. Compounds are displayed with a + sign in between the compound parts, e.g. APPLE+PIE. Compound parts are also displayed, with an asterisk * marking the site of connection to the other part of the compound. So, for example, the primary entry APPLE is listed with the entry/variants shown in Figure 5.

Current Signs in Sign Bank	
APPLE	
APPLE (19)	
(S)APPLE (2)	
APPLE* (APPLE+JUICE) (1)	
APPLE* (APPLE+PIE) (1)	
APPLE+JUICE	
APPLE+JUICE (1)	
APPLE+PIE	
APPLE+PIE (1)	

Figure 5. Variants Shown for the sign APPLE

As shown here, the sign APPLE has an entry/variant produced with the “S” handsape, and the sign also occurs as part of the compounds APPLE+JUICE and APPLE+PIE. These are arbitrary labels, not intended to be exact translations. The key criterion is that we have a unique correspondence of label and sign. This is critical to use of these data, e.g., for machine learning (Neidle, *et al.* 2022a).

The number in parentheses provided after the gloss label indicates the total number of examples of that entry/variant in our collection. For example, we have 7 occurrences of the sign variant labelled (nd-S)APPOINTMENT, as shown in Figure 6. The selected sign is displayed with the option to view the video examples in our collection.

Sign Search Results
 Playing the "sign video" will play from the start to the end frame of the sign itself.
 Playing the "sign clip" will include frames before and after those in the "sign video".

Occurrences for Sign Variant: (nd-S)APPOINTMENT
 Show Related English Words → See next page

ASLLVD isolated signs		DH-Start	ND-Start	DH-End	ND-End	ID	Play
<input type="radio"/>	(nd-S)APPOINTMENT					593	Sign clip Composite video Original sign video
<input checked="" type="radio"/>	(nd-S)APPOINTMENT					592	Sign clip Composite video Original sign video

DawnSignPress isolated signs		DH-Start	ND-Start	DH-End	ND-End	ID	Sign File	Play
<input type="radio"/>	(nd-S)APPOINTMENT					355032	JB_PM-vocab-053118_TC	Sign video Sign clip

DawnSignPress signs from sentences		DH-Start	ND-Start	DH-End	ND-End	ID	Sign File	Play
<input type="radio"/>	(nd-S)APPOINTMENT					323412	JulB-sentences-012418_TC_hb	Sign video Utterance video

RIT isolated signs		DH-Start	ND-Start	DH-End	ND-End	ID	Sign File	Play
<input type="radio"/>	(nd-S)APPOINTMENT					372973	PF02_V03_RIT	Sign clip
<input type="radio"/>	(nd-S)APPOINTMENT					379387	PF17_V01_RIT	Sign clip
<input type="radio"/>	(nd-S)APPOINTMENT					377699	PF18_V01_RIT-p3	Sign clip

Figure 6. Available Videos for (nd-S)APPOINTMENT

In some cases, there is the option to play either the sign video or the sign clip (showing only the portion of the video from the linguistic start point of the sign through the linguistic end point of the sign). For signs from our ASLLVD collection, it is possible to play the “Composite video” to view all

examples played simultaneously. For signs pre-segmented from our continuous signing videos, it is also possible to play the containing utterance. “Related English Words” can also be displayed by clicking the button near the top of the display; see example in Figure 7.

Related English Words for Sign Variant: (nd-S)APPOINTMENT		
Variant ID	Variant Label	Related English Words
295	(nd-S)APPOINTMENT	appointment, commitment, engagement, meeting, reservation, reserve

Figure 7. Related English Words for (nd-S)APPOINTMENT

The newest option for searching for a sign is to “Search by Video Example” (Neidle, et al. 2024). Clicking on the button at the bottom of Figure 4² brings up the window shown in Figure 8.

Sign Recognition

Choose File No file chosen

Select uploaded video sign type:

Citation-form sign

Sign segmented from continuous signing

To ensure privacy, the video you upload will be deleted from our site immediately after the processing has been completed.

Click to Search by Video Example
Click to View/Update Class Labels

Privacy notice. All videos uploaded to sign recognition. No videos will be retained. They have been processed for

Information about uploading video files:

- Video files should contain a single ASL sign.
- For webcam recordings, the user should be facing the camera, and should make an effort to keep the hands visible from the beginning to the end of the video.
- Acceptable video formats include mp4, mov. Please make sure that the video file can be played with QuickTime.
- Please keep the duration of the video under 7 seconds.
- If you are editing a continuous signing video (e.g., a sentence) to extract an unknown sign for lookup, choose the linguistic start and end points of the segmented sign to be the start and end points of your video clip.
- Video filenames should not contain any special characters (only letters, numbers, and these symbols: - _ .)

Request for feedback: We would very much appreciate any comments on the use of this new feature—e.g., the extent to which you find it helpful—as well as any suggestions. Please send [email](#).

Figure 8. Search by Video Example Interface

The user selects a video clip containing a single sign to upload. The user is asked to specify whether this is a citation-form sign (e.g., from the webcam recording), or a sign segmented from a continuous signing video. In the latter case, the user should choose the linguistic start and end points of the sign to also be the start and end points of the edited video clip. The processing takes about a minute, after which the user is shown their own source video (which will be deleted after processing is complete, to preserve privacy), followed by the top 5 most likely matches, as shown in Figure 6.³

² Login is required to access this feature, but users can easily request a free account. Users will be taken first to the login page if they are not logged in when they select “Search by Video Example.”

³ This is based on the sign recognition research reported in Zhou, et al. (2024).

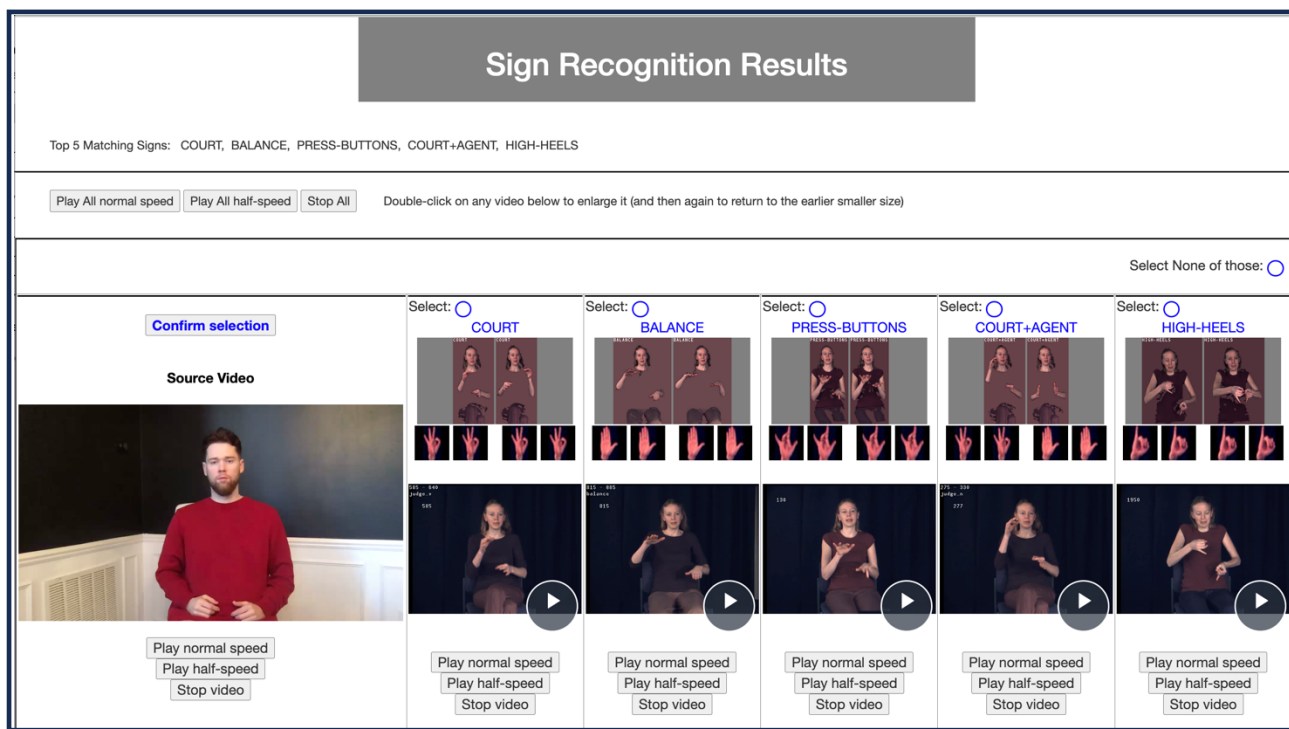


Figure 9. Search by Video Example: Recognition Results for the uploaded video for COURT

The user can play any or all of the videos—at regular or half-speed—before making a selection. The user can also double-click on any video to enlarge it to full screen, and then again, to return to the earlier smaller size.

If there are lexical variants of any of the suggested signs, the user can see those before selecting the appropriate main entry, as shown on the left in Figure 10. The user is then invited to make a final selection, as shown on the right in that same figure, before being taken to the entry of the selected entry/variant in our Sign Bank (as illustrated in Figure 6).

3. SIGNS THAT CAN BE RECOGNIZED BY THIS SYSTEM

In all, about 2,360 distinct signs can currently be recognized via video lookup, including lexical signs, loan signs, numbers, and compounds; see Section 4. Our current recognition accuracy for proficient ASL signers is as follows:

Type of video input	Top-1	Top-5
Citation-form signs	81.21 %	95.36 %
Signs segmented from continuous signing	80.39 %	92.96 %

Table 1. Recognition Accuracy

Sign videos from ASL learners, which may differ in production from signs articulated by proficient signers, may be less well recognized.⁴ If the search by video example does not produce the desired result, the user can “Select None of those” (at the upper right Figure 9 in which case the user will be returned to the main Sign Bank page, and can proceed to search for the desired sign in other ways (as described in Section 4).


⁴ In collaboration with Matt Huenerfauth at RIT, we plan to carry out user studies in the near future to establish the recognition accuracy for ASL learners.

Top 5 Matching Signs: #BACK, LAST-YEAR, #BANK, COME-HERE, PINK

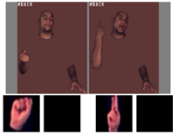

Double-click on any video below to enlarge)

Confirm selection

Source Video

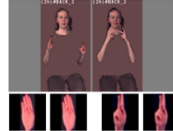



Select: #BACK


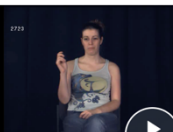



[See Variants](#)

(2h)#BACK_2

#BACK_2






ASLLRP Sign Bank

Select below
Confirm Final Selection

Options for #BACK

#BACK

#BACK 

#BACK_2 

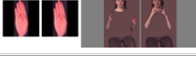
(2h)#BACK_2 

Figure 10. Ability to View Sign Variants before Confirming Selection

4. SOME LIMITATIONS WITH RESPECT TO SIGNS THAT CAN BE SEARCHED VIA LOOKUP-BY-VIDEO-EXAMPLE

The signs that can be identified by our current lookup system do **not** include signs of the following types (except when they are included as components of compounds), although these sign types are included in the ASLLRP Sign Bank:

- *Fingerspelled signs, classifiers, and gestures.*
- *Index signs.* These signs, which involve pointing to a spatial location that represents a referent or location, are not recognized by video example. Pointing signs have many different uses, meanings, and realizations depending on the context in which they occur. The signs often glossed as IX, in which the pointing is carried out by the index finger, can be used as determiners, locatives, or pronouns, for example. Possessives (produced by pointing with an open palm to the possessor) are also not searchable through uploaded video examples.



Figure 11. Index Signs not Accessible through Lookup-by-video-example

5. OVERVIEW OF AVAILABLE DATA

For statistics of data in the ASLLRP Sign Bank, see <https://dai.cs.rutgers.edu/dai/s/runningstats>. Further information about these resources is also available (Neidle, *et al.* 2022b), as is further information about our annotation (Neidle 2002, 2007).

6. DOWNLOAD OPTIONS

Users who wish to download data can request a free account. They need to agree to respect the terms of use. Once signed in, they can download data in various ways.

Continuous Signing Data

Once users conduct a search, as described in Section 1, the results are displayed with the option to select data of interest, as shown in Figure 12. The SignStream® collection containing the item of interest will to be added to the Download Cart.

The screenshot shows the ASLLRP SignStream@ 3 Corpus interface. On the left is a navigation menu with options like Sign Search, Utterance Search, Sign Bank, Acknowledgments & Credits, Statistics, Help, Terms of Use, Account Admin, Change my account details, Change Other User's Accounts, and Logout. Below the menu is a 'Collections cart' section with buttons for 'Add collection(s) to cart', 'Go to cart', and 'Clear cart'. The main area is a table with columns: File Name-Utterance, Utterance Video, Sign Video, View, and Rough Gloss. Three rows are visible, each with a video thumbnail and a 'Gloss..' button. The first row is selected, and its gloss is shown on the right. The gloss includes linguistic annotations like 'topic/focus:', 'negative:', 'dh: OFTEN+ MOTHER+FATHER OH-I-SEE REALLY (2h)#OK part:indef OFTEN THAT:1 GONE', 'dh shape:', 'ndh: OFTEN+ (2h)#OK part:indef OFTEN GONE', 'ndh shape:', and 'enlg trans: The parents will realize and embraces the situation more calmly. Without a De'.

Figure 12. Data of Interest can be Added to the Download Cart

The Download Cart provides access to all the SignStream® collections that are downloadable, and any that the user has explicitly selected will be checked, but users can also add additional collections for download, or download the entire set, as they wish. This is shown in Figure 11.

The screenshot shows the 'Download Selected Collections' page. At the top, there are links for 'Information about the Download Cart' and 'Information about the SignStream@ XML Extract Format'. Below these is a notice: 'Important: By downloading anything from this page, you are agreeing to abide by the Terms of Use.' The main content is a table with the following columns: Selection (with 'Select All' and 'Un-select All' buttons), Collection, Version, Created, Modified, Select SignStream Collection for Download (with 'Select All' and 'Un-select All' buttons), Select XML Extract for Download (with 'Select All' and 'Un-select All' buttons), Select Video Files for Download (with 'Select All' and 'Un-select All' buttons), and Download Selected Items (by row) (with 'Download' buttons). The table lists several collections, including '1-Ben-Introduction', '10-Ben-Conclusion', '2-Ben-Voice-Identity', '3-Ben-Voice-Life', and 'Rachel_2012-02-14_sc66'. The 'Rachel_2012-02-14_sc66' row is selected, with a blue checkmark in the 'Select SignStream Collection for Download' column and 'Download' buttons in the 'Download Selected Items' column.

Figure 13. Download Cart

The user can download the video files for the selections and can download the annotations in two forms: as a SignStream® file (which can be opened using SignStream® software), and/or in an XML extract, which may be easier to use; the format is explained from that site.

Individual Sign Data

From the bottom of the main Sign Bank page shown in Figure 1, users can navigate to pages for download of isolated, citation-form sign data or (a recent addition!) for signs segmented from continuous signing:

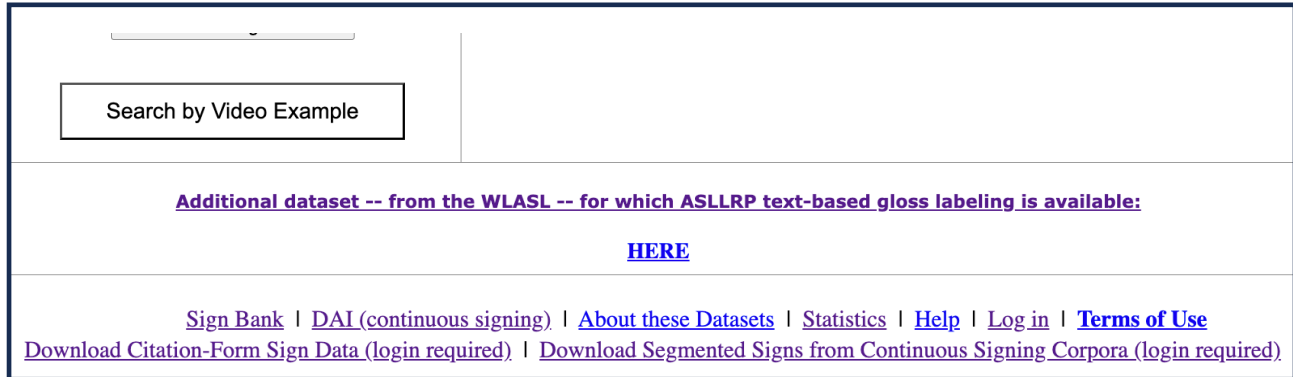


Figure 14. Download Pages for Sign Bank Sign Data

These pages allow download of complete collections, for download of the video files and spreadsheets containing information about the data (Neidle & Opoku 2022). Explanations are provided about the contents of those spreadsheets, e.g., as shown for isolated, citation-form datasets, in Figure 15.

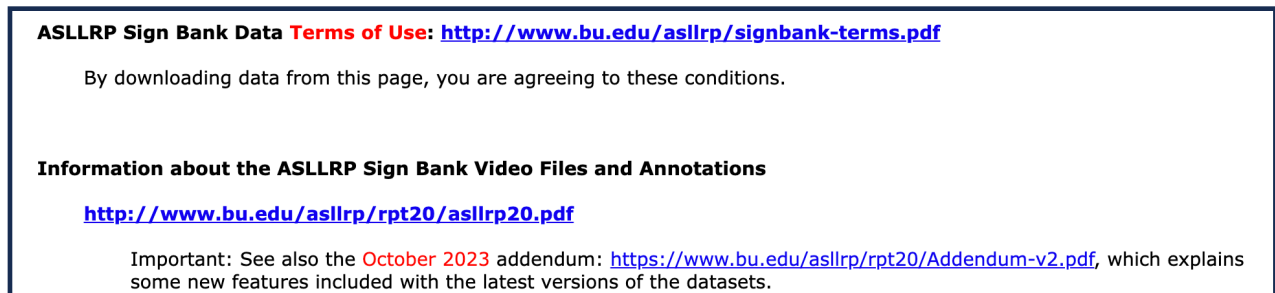


Figure 15. Explanations Provided about Data Available for Download

Separately, we also provide gloss labels for a large subset of the WLASL data consistent with the glossing conventions for the ASLLRP Sign Bank. The WLASL (Li, *et al.* 2020) is a large video dataset for Word-Level American Sign Language recognition, available for download. It brings together many different sets of ASL videos that had been shared publicly. However, there is a serious lack of consistency in the gloss labeling associated with signs across the multiple datasets (Neidle, *et al.* 2022a). See <http://www.bu.edu/asllrp/rpt21/asllrp21.pdf>. These annotations can increase the value of the WLASL data for sign recognition research, by virtue of the consistency in the labels attached to the signs in these collections. Our revised gloss labeling also makes it possible to put data from the WLASL and the ASLLRP Sign Bank together, to create an even larger and richer resource than either of these data sources on their own.

7. ACCESS TO THE SIGN BANK FROM WITHIN SIGNSTREAM®

From SignStream® Versions Left through 3.4.1

Current and recent versions of SignStream® incorporate the ability to search our Sign Bank via gloss text and/or handshape information, and then to insert the selected sign's properties directly into the annotation (subject to any further editing), as shown in Figure 16. This greatly enhances the efficiency and consistency of annotations.

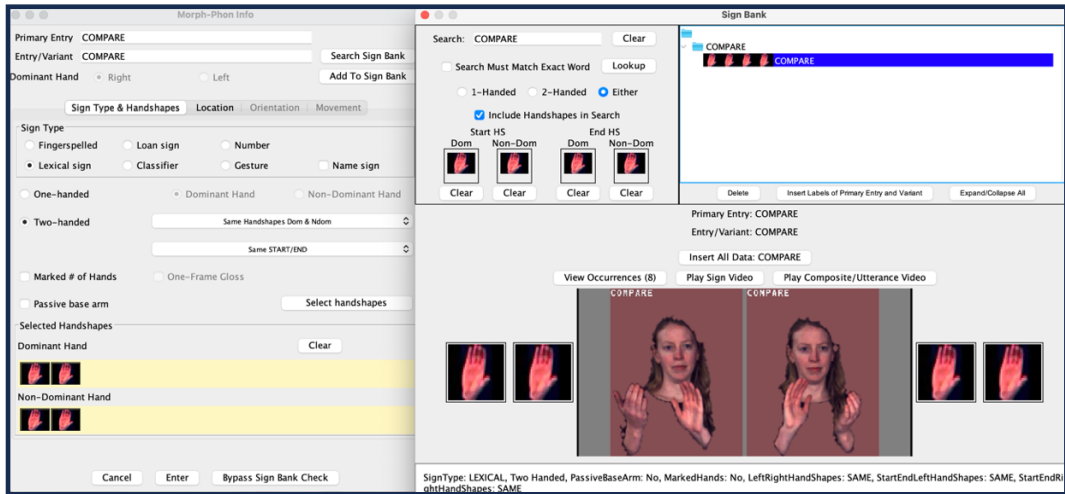


Figure 16. Sign Bank Search from within SignStream®

The information can then be directly entered into the main sentence-level annotation, as seen in Figure 17.

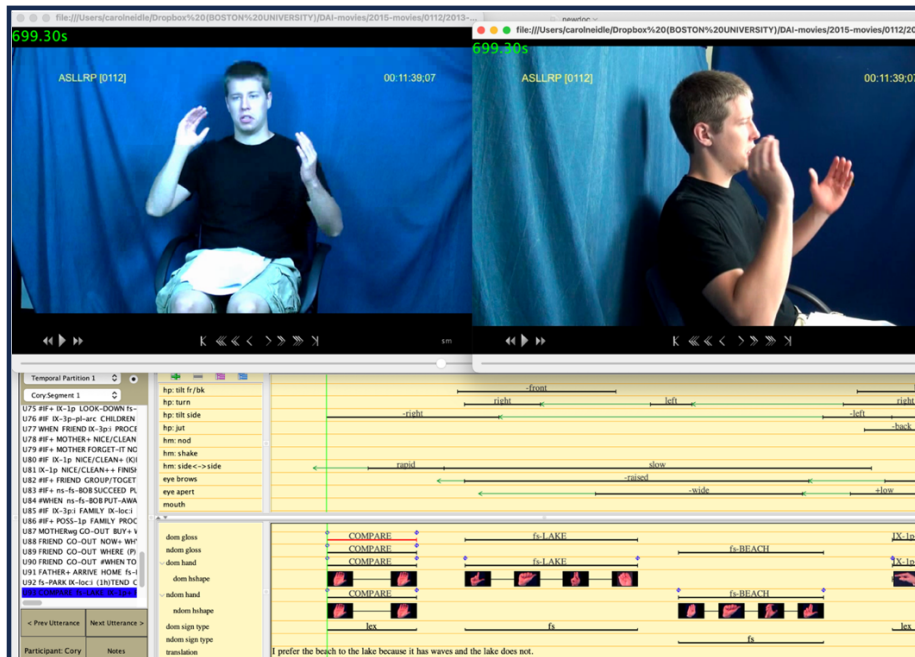


Figure 17. Sign Information Entered into the Utterance within SignStream®

From the Forthcoming SignStream® Update

The newest version of SignStream®, to be released in Summer 2024 (Neidle 2024 (forthcoming)), makes it possible, once the user has set start and end points of an unknown sign, to search for that sign through the search-by-video-example module, and then, upon confirmation of the target sign, to enter the Sign Bank information directly into the SignStream® annotation.

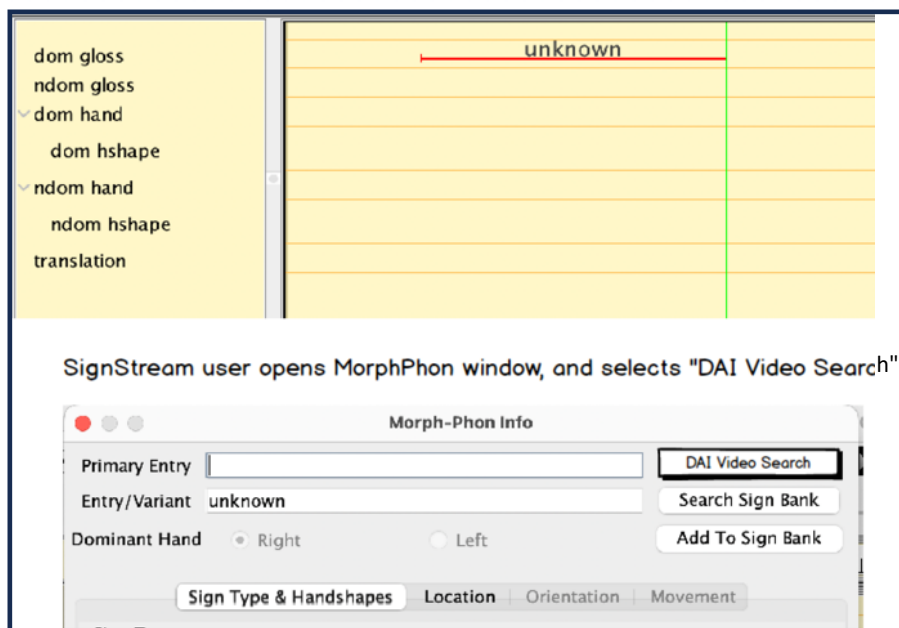


Figure 18. Brand New Search-by-video-example Feature within SignStream®

8. CREDITS AND ACKNOWLEDGMENTS

Augustine Opoku has been our Web designer. He is responsible for development and maintenance of the website (<https://dai.cs.rutgers.edu/dai/s/dai>) through which we share linguistic data and enable the search by video example. The analysis of submitted videos for lookup is carried out behind the scenes by a system that was designed and implemented by Yang Zhou, Xiaoxiao He, and (for our initial version) Konstantinos Dafnis, under the supervision of Dimitris Metaxas. Development of SignStream®, our software for linguistic annotation of ASL video data (available from <https://www.bu.edu/asllrp/SignStream/3/>) has been carried out principally by Gregory Dimitriadis, at the LCSR (Laboratory for Computer Science Research) at Rutgers University. Carey Ballard has provided assistance and advice on many aspects of these projects, and he has been invaluable in helping with annotations and verifications.

We are grateful to the many people who have helped with the collection, linguistic annotation, and sharing of the ASL data upon which we have relied for this research. In particular, we are indebted to the many ASL signers who have contributed to our database; to Matt Huenerfauth and his team for data collection at RIT; to DawnSignPress for sharing video data; to the many who have helped with linguistic annotations.

This work was supported in part by NSF grants #2235405, #2212302, #2212301, and #2212303, but any opinions, findings, and conclusions expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

9. REFERENCES

- Li, Dongxu, Cristian Rodriguez, Xin Yu & Hongdong Li. 2020. Word-level deep sign language recognition from video: A new large-scale dataset and methods comparison. In Proceedings of the IEEE/CVF winter conference on applications of computer vision. 10.18653/v1/2022.acl-demo.8. <https://aclanthology.org/2022.acl-demo.8>.
- Neidle, Carol. 2002. *SignStream™ Annotation: Conventions used for the American Sign Language Linguistic Research Project*. Boston University, ASLLRP Project Report No. 11 <http://www.bu.edu/asllrp/asllrpr11.pdf>.
- . 2007. *SignStream™ Annotation: Addendum to Conventions used for the American Sign Language Linguistic Research Project*. Boston University, ASLLRP Project Report No. 13 <http://www.bu.edu/asllrp/asllrpr13.pdf>.
- . 2017. *A User's Guide to SignStream® 3*. American Sign Language Linguistic Research Project Report No. 15, Boston University https://www.bu.edu/asllrp/SignStream/3/SS_User-guide.pdf
- . 2018. *What's New in SignStream® 3.1.0?* Boston University, ASLLRP Project Report No. 16 http://www.bu.edu/asllrp/SignStream/3/SS_update.pdf.
- . 2020. *What's New in SignStream® 3.3.0?* Boston University, ASLLRP Project Report No. 17 http://www.bu.edu/asllrp/SignStream/3/SS_update-3_3.pdf.
- . 2022. *What's New in SignStream® 3.4.0?* Boston University, ASLLRP Project Report No. 22 <http://www.bu.edu/asllrp/rpt22/asllrp22.pdf>.
- . 2024 (forthcoming). *What's New in SignStream® 3.5.0 ?* Boston University, ASLLRP Project Report No. 26 <http://www.bu.edu/asllrp/rpt26/asllrp26.pdf>.
- Neidle, Carol & Augustine Opoku. 2022. *Documentation for Download of ASLLRP Sign Bank Citation-Form Sign Datasets*. Boston University, ASLLRP Project Report No. 20 <http://www.bu.edu/asllrp/rpt20/asllrp20.pdf>.
- Neidle, Carol, Augustine Opoku, Carey Ballard, Konstantinos M. Dafnis, Evgenia Chroni & Dimitris Metaxas. 2022a. Resources for Computer-Based Sign Recognition from Video, and the Criticality of Consistency of Gloss Labeling across Multiple Large ASL Video Corpora. 10th Workshop on the Representation and Processing of Sign Languages: Multilingual Sign Language Resources. LREC, Marseille, France. <https://aclanthology.org/2022.signlang-1.26.pdf>.
- Neidle, Carol, Augustine Opoku, Carey Ballard, Yang Zhou, Xiaoxiao He & Dimitris Metaxas. 2024. New Capability to Look Up an ASL Sign from a Video Example. arXiv:2407.13571 [cs.CV] pp. 1-11. <https://arxiv.org/abs/2407.13571>.

- Neidle, Carol, Augustine Opoku, Gregory Dimitriadis & Dimitris Metaxas. 2018. NEW Shared & Interconnected ASL Resources: SignStream® 3 Software; DAI 2 for Web Access to Linguistically Annotated Video Corpora; and a Sign Bank. 8th Workshop on the Representation and Processing of Sign Languages: Involving the Language Community. LREC, May 2018, Miyagawa, Japan. <https://open.bu.edu/handle/2144/30047>.
- Neidle, Carol, Augustine Opoku & Dimitris Metaxas. 2022b. ASL Video Corpora & Sign Bank: Resources Available through the American Sign Language Linguistic Research Project (ASLLRP). *arXiv:2201.07899*. <https://arxiv.org/abs/2201.07899>.
- Neidle, Carol, Ashwin Thangali & Stan Sclaroff. 2012. Challenges in Development of the American Sign Language Lexicon Video Dataset (ASLLVD) Corpus. 5th Workshop on the Representation and Processing of Sign Languages: Interactions between Corpus and Lexicon. LREC, Istanbul, Turkey. May 2012. <https://open.bu.edu/handle/2144/31899>.
- Zhou, Yang, Zhaoyang Xia, Yuxiao Chen, Carol Neidle & Dimitris Metaxas. 2024. A Multimodal Spatio-Temporal GCN Model with Enhancements for Isolated Sign Recognition. LREC-COLING 2024 11th Workshop on the Representation and Processing of Sign Languages: Evaluation of Sign Language Resources, Torino, Italy. <https://www.sign-lang.uni-hamburg.de/lrec/pub/24015.pdf>

10. TABLE OF FIGURES

Figure 1. Sign Search - in SignStream® Collections	1
Figure 2. Example of Sign Search Results – Multiple views of Signs and Utterances can be played... 2	2
Figure 3. Utterance Search Options	4
Figure 4. Search Options for Individual Signs – both Citation-form Signs and Signs Pre-segmented from Continuous Signing.....	5
Figure 5. Variants Shown for the sign APPLE	6
Figure 6. Available Videos for (nd-S)APPOINTMENT	6
Figure 7. Related English Words for (nd-S)APPOINTMENT	7
Figure 8. Search by Video Example Interface	7
Figure 9. Search by Video Example: Recognition Results for the uploaded video for COURT	8
Figure 10. Ability to View Sign Variants before Confirming Selection	9
Figure 11. Index Signs not Accessible through Lookup-by-video-example	10
Figure 12. Data of Interest can be Added to the Download Cart.....	11
Figure 13. Download Cart	11
Figure 14. Download Pages for Sign Bank Sign Data.....	12
Figure 15. Explanations Provided about Data Available for Download	12
Figure 16. Sign Bank Search from within SignStream®	13
Figure 17. Sign Information Entered into the Utterance within SignStream®	13
Figure 18. Brand New Search-by-video-example Feature within SignStream®	14

11. TABLE OF CONTENTS

1.	DATA ACCESS INTERFACE: CONTINUOUS SIGNING DATA (UTTERANCES) -- https://dai.cs.rutgers.edu/dai/s/dai	1
2.	SIGN BANK: INDIVIDUAL SIGNS -- https://dai.cs.rutgers.edu/dai/s/signbank	4
3.	SIGNS THAT CAN BE RECOGNIZED BY THIS SYSTEM	8
4.	SOME LIMITATIONS WITH RESPECT TO SIGNS THAT CAN BE SEARCHED VIA LOOKUP-BY-VIDEO-EXAMPLE	10
5.	OVERVIEW OF AVAILABLE DATA	10
6.	DOWNLOAD OPTIONS	10
	Continuous Signing Data	10
	Individual Sign Data	12
7.	ACCESS TO THE SIGN BANK FROM WITHIN SIGNSTREAM®	13
	From SignStream® Versions through 3.4.1	13
	From the Forthcoming SignStream® Update	14
8.	CREDITS AND ACKNOWLEDGMENTS	14
9.	REFERENCES	15
10.	TABLE OF FIGURES	17
11.	TABLE OF CONTENTS	18