



COMPUTERIZED SPELLING SENSITIVITY SYSTEM (CSSS)

Manual

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Computerized Spelling Sensitivity System Manual

Acknowledgements

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Julie Masterson

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Purpose and Description of CSSS

The *Spelling Sensitivity System* was developed by Masterson and Apel (2007; 2010; 2013) to reflect the level of linguistic knowledge demonstrated by individual spellings. This system incorporates the following linguistic skills, which underlie competent spelling: phonemic awareness, orthographic pattern awareness, morphological awareness, and storage of mental graphemic representations (MGRs). The *Computerized Spelling Sensitivity System* was created by Masterson and Hrbec (2011) to increase both efficiency and reliability of the system. The SSS has been used to characterize variations in spelling associated with cultural differences (Williams & Masterson, 2010), developmental changes (Apel, Fowler, Conlin, Masterson, & Goldstein, 2008; Masterson & Apel, 2010), and spellings of children with speech and/or language disabilities (Willer Overby & Masterson, 2013; Masterson & Preston, 2012), and response to intervention (Masterson & Apel, 2013).

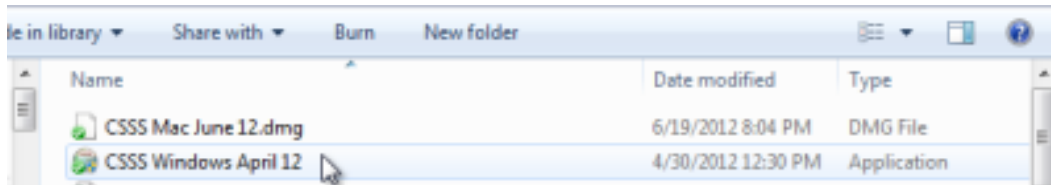
In this system, an individual's spellings are parsed or segmented into elements, aligned with the target elements, and scored on a 4-point scale representing linguistic accuracy. *Spelling elements* are defined as (a) the letter or letters associated with each phoneme in a base word or stem, (b) spelling modifications associated with changes to a base word or stem when adding an affix (i.e., junctures), and (c) the letter or letters used to spell an affix. If an element is spelled correctly, it is given a score of 3 points. If an element is not represented by a spelling, it is scored as 0. Examples include omitting the n and spelling hand as HAD, failing to add a juncture change such as spelling hitting as HITING, or failing to add an affix, spelling walked as WALK. If an element is spelled incorrectly, the score is based on the linguistic plausibility of the spelling used. If it is orthographically or morphologically legal (i.e., correct in some words), it is scored as a 2. For example, the spelling the vowel in rain with the a-consonant-e pattern, RANE, is legal, so that element would be given 2 points. On the other hand, if the vowel was spelled with a single vowel letter, RAN, the element would be given 1 point. Classification and associated rationale of various spellings are illustrated in Table 1.

Table 1

Target/ Parsing	Spelling/ Parsing	Scoring and Rationale
APPEALING a pp ea ling	APPEALING a pp ea ling	All elements are spelled correctly, so each would be given a 3.
FEED f ee d	FEAD f ea d	The <i>f</i> and <i>d</i> are spelled correctly, so they are each given a 3. The <i>ee</i> is spelled as <i>ea</i> , which is a plausible way to spell the <i>long e</i> sound (e.g., <i>bead</i> , <i>read</i>), so it is given 2 points.
BANGED b a ng ed	BANGD b a ng d	The <i>f</i> and <i>d</i> are spelled correctly, so they are each given a 3. The affix <i>ed</i> is spelled with a <i>d</i> . Regardless of how the sound is pronounced, it not a plausible spelling for the past tense morpheme, so it is given a 1.
CATCH c a tch	CH c # h	The <i>c</i> is spelled correctly, so it is given a 3. The <i>tch</i> is not spelled with a plausible spelling, so it is given a 1. The <i>a</i> is not represented with a spelling at all, so it is given a 0.

Installing CSSS

To install CSSS, locate the software link on the Missouri State University Language-Literacy Lab webpage at www.missouristate.edu/csd/lll. There are two software options at this site, (e.g., CSSS Mac.dmg for Macintosh users or CSSS Windows for PC/Windows users) so install the appropriate option for your operating system.

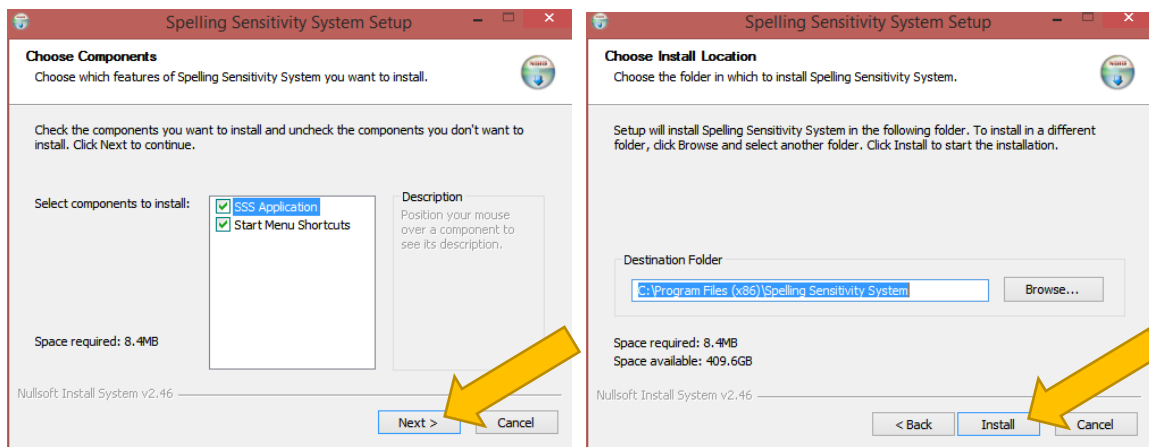


To install, double click on the link and select DOWNLOAD, then select RUN in the following pop-up box. Once your computer runs the software, you will be prompted to select components to install. Be sure to select both the SSS Application and Start Menu Shortcuts for the program then select NEXT.

After selecting NEXT, you will be provided with an additional pop-up box to INSTALL. Before selecting INSTALL, note the pathway for locating the program after installation. You can find this in the Destination Folder on this pop-up box.

After installation is complete, locate the program from the predetermined pathway in the installation pop-up box and double-click to open.

Figure 1: Examples of Spelling Sensitivity System Setup Pop-Up



Classification of Spellings: The CSSS Dictionary

The classification of spellings as correct, legal, illegal, or omitted is based on the entries for target words that are stored in the dictionary used by the system. Each target word included in the dictionary is parsed into spelling elements according to the principles described in the previous section. Spelling elements are delineated by placing SPACES between each one. Parsing examples appear in Table 2.

Table 2: Parsing examples

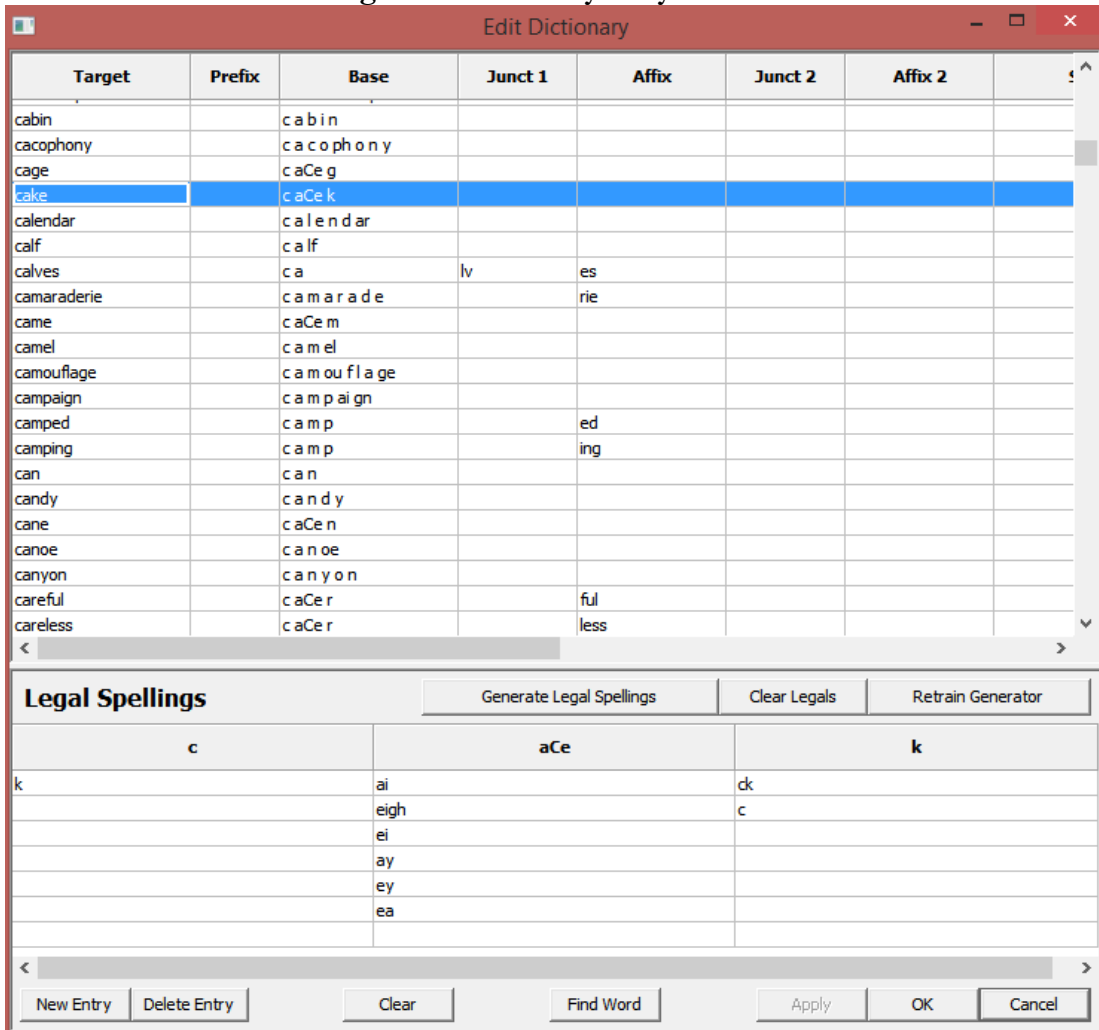
Target Word	Spelling Elements	Comments
cake	c aCe k	The pattern, “vowel-consonant-e” is used to represent the vowel.
bus	b u s	Each consonant sound is represented by a single letter
check	ch e ck	The first and third consonant sounds are each represented by digraphs.
hitting	h i t t ing	The juncture segment requires doubling the final consonant in the word HIT before adding the suffix <i>ing</i>
tubing	t u b ing	The juncture segment requires dropping the <i>e</i> in TUBE before adding the suffix <i>ing</i>
abbreviation	ab b r e v i a t ion	The juncture segment requires dropping the <i>e</i> in the base word ABBREVIATE and adding the <i>ion</i> affix.

After a word has been parsed, each element appears in a table. Legal spellings for each element are entered in the cells below. See Table 3 for examples of legal spellings for the word CAKE. See Figure 2 (on page 7) for a screen shot of the dictionary entry for CAKE.

Table 3: Legal spellings for cake

Target Spelling	Spelling Elements		
	c	aCe	k
Legal Spellings	K (kick)	eigh	c (tic)
	Ch (choir)	ei	Ck (pack)
		ay	Ch (
		ey	que
		ea	

Figure 2: Dictionary entry for cake



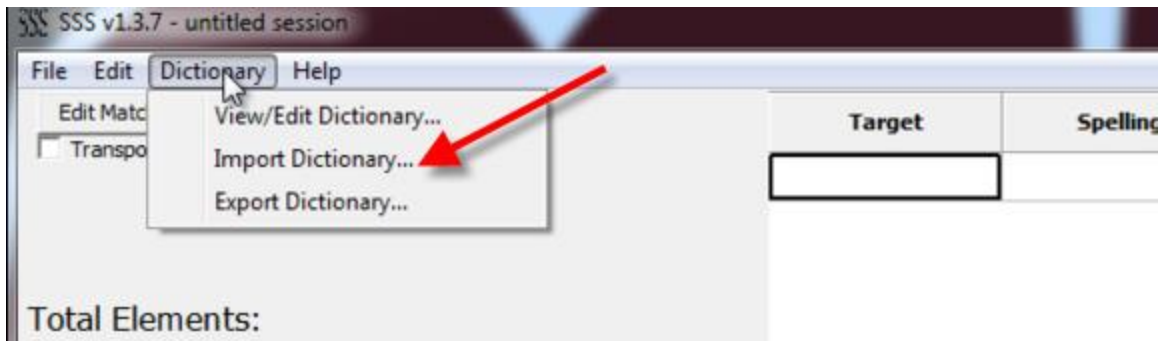
The CSSS analyses will not work unless every target word in a sample is included in the active CSSS Dictionary. Users can import a dictionary from the CSSS website, which currently contains approximately 1300 words that have been parsed into elements with legal spellings included. Alternatively, they can enter their own words, parse them into elements, and add legal spellings. Regardless of the method used to establish the dictionary, users should be familiar with the manner in which words have been parsed and the selection of spellings considered legal.

The user can make changes in both parsing and assignment of legal spellings by modifying entries in the dictionary. Some modifications may be necessary to account for differences in legal spellings associated with variations in pronunciation across dialects. For example, a rhotic dialect of English (i.e., the /r/ is pronounced regardless of whether it is followed by a vowel or not) is used in most parts of the United States, so the word march would have four spelling elements (m a r ch) in those regions. However, in some regions of the United States, as well as Great Britain and Australia, citizens may use a non-rhotic dialect of English (i.e., /r/ is pronounced only if it is followed by a vowel). In these areas, the word march would have only three spelling elements (m a r ch) since the /r/ would be silent.

Importing and Exporting the Dictionary

The CSSS Dictionary can be exported for use on other computers. Instructions for importing and exporting a dictionary and for adding new words or modifying entries for existing words are provided below.

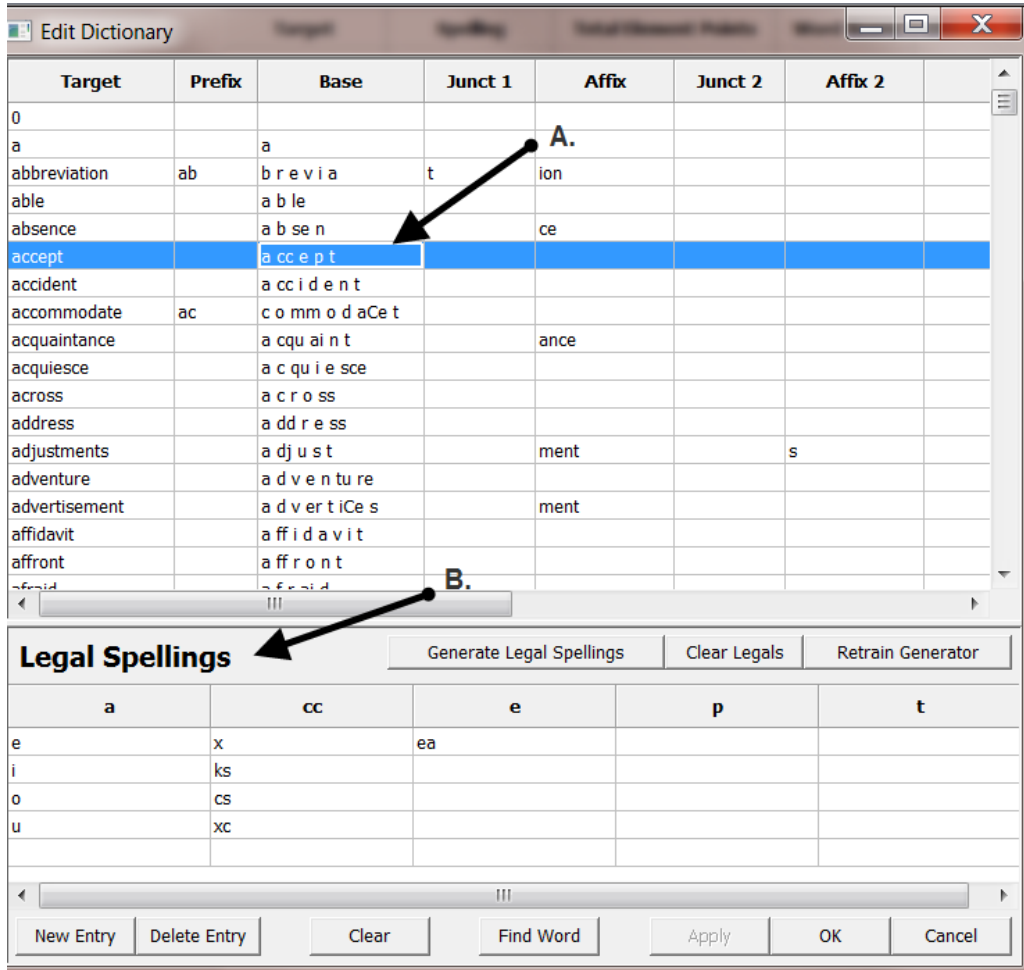
1. To **import** the dictionary, select **DICTIONARY** on the toolbar then select “**IMPORT DICTIONARY**”.



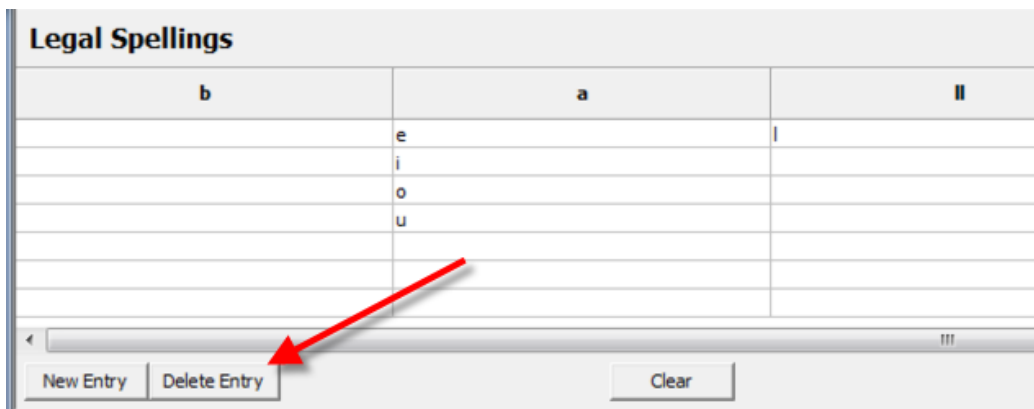
2. The CSSS Dictionary may be modified by the user to account for differences in legal spellings associated with variations in pronunciation across dialects. To **modify the dictionary**, select **DICTIONARY** on the toolbar then **VIEW/EDIT DICTIONARY**. Use the pop-up box to search for words. This gives you the opportunity to view how words are parsed along with legal spellings for each element of the word (e.g., base, juncture, and affix).



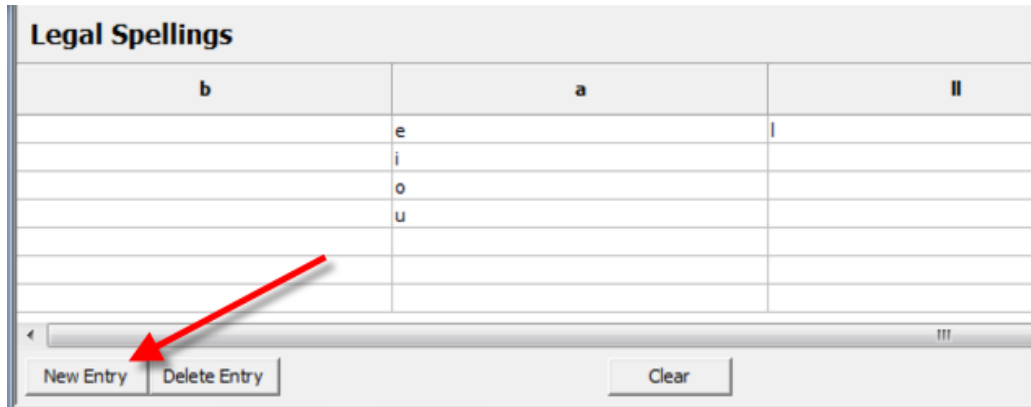
Use the cursor to **highlight the entry**. Parsing of elements and classification as base, juncture, or affix can be modified by using the space bar or entering into the appropriate column (see arrow A below). Modification of spellings that will be counted as legal (and given a score of 2) can be modified in the table of legal spellings that appears at the bottom of the screen for the highlighted word (see arrow B below).



b. To **delete an existing entry**, select the target word on the pop-up box and delete.



- c. To **add a word**, select NEW ENTRY and enter the target word, parse it into elements and legal spellings for each addition.



3. To **export the dictionary**, select DICTIONARY on the toolbar, EXPORT DICTIONARY, then save the new dictionary in the desired location.



Entering Student Spellings: Determining Analyzability, Parsing, and Alignment

Data for analysis can be collected in various ways (e.g., predetermined word lists, connected writing samples, etc.). All spellings must be entered in lower case letters and entries cannot contain any extra spaces or punctuation.

Determining CSSS Analyzability

CSSS analyses is useful only if the correspondence between a students' spelling and the target word is sufficient to allow reasonable conclusions about the level of linguistic awareness it represents. Any target spelling for which there is no student attempt should be excluded from the sample. Next, each item must be classified as an analyzable or non-analyzable attempt of the target spelling. To be considered an *analyzable attempt*, the spelling should include two elements that were either spelled correctly or represented by a common legal spelling or diagraph. The number or percent of unanalyzable spellings itself can be a valuable measure of the spelling accuracy of students (see Masterson & Apel, 2014, for an example).

Entering Analyzable Spellings into CSSS

1. Entering data directly into CSSS (New Session): Data may be entered into the CSSS program directly. You can do this by opening the CSSS program, placing your cursor in the top left cell and typing your data. Target words must be placed in column A with attempts placed in column B.

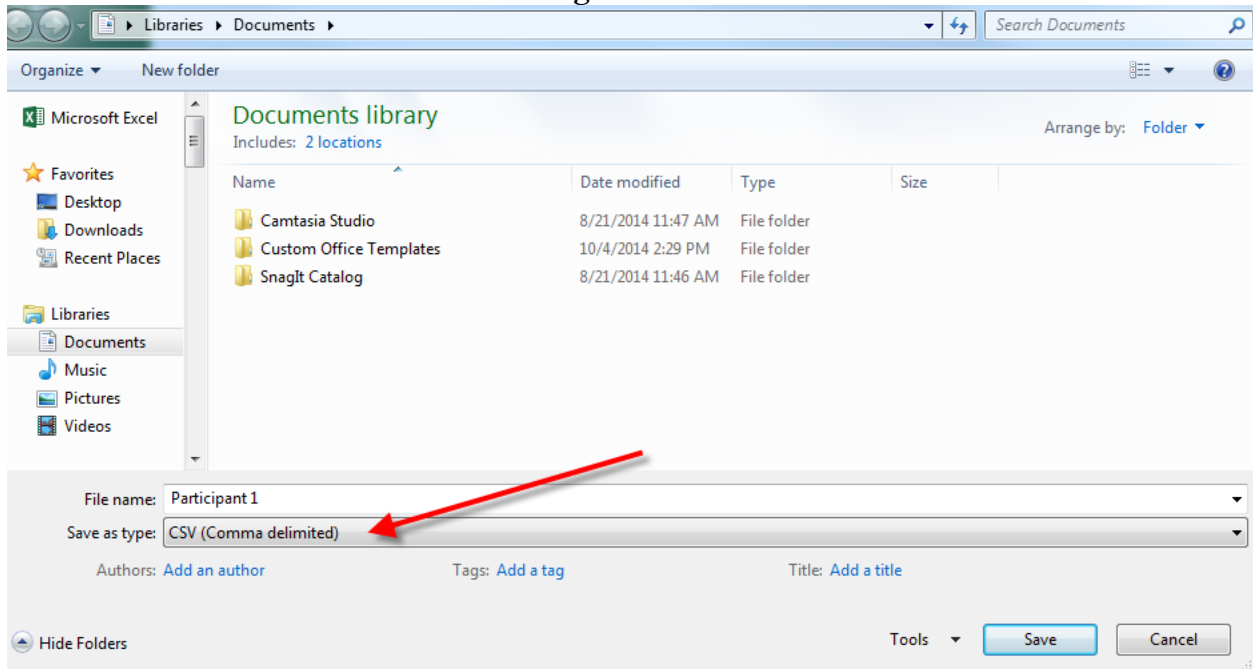
Target	Spelling	Total Element Points	Word Score
bake	bak	7	1

2. Entering data via a spreadsheet (New Session from CSV File): To use the CSSS, target spellings and associated user spellings are stored in a spreadsheet (typically Excel) in a comma-separated-value (CSV) format. Target spellings appear in Column A, and the corresponding student spellings go in Column B. The file then is imported into the CSSS.

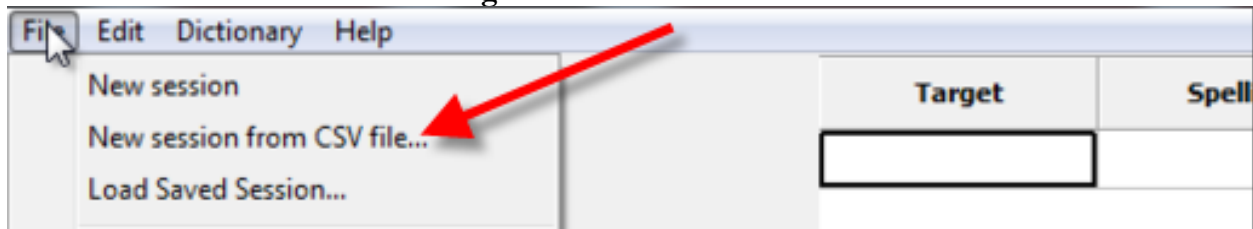
The screenshot shows the Microsoft Excel ribbon with the 'HOME' tab selected. The ribbon includes options for Clipboard (Cut, Copy, Paste, Format Painter), Font (Calibri, 11, Bold, Italic, Underline, Color, Background Color), Alignment (Wrap Text, Merge & Center), and Number (General, Currency, Percentage, Decimals, Fractions). Below the ribbon, the spreadsheet grid is visible with columns A through O and rows 1 through 8. The data in the spreadsheet is as follows:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	honey	honey													
2	why	wy													
3	leaf	leef													
4	jet	jet													
5	unite	unice													
6	cure	suce													
7	pennies	pennys													
8	pool	pool													

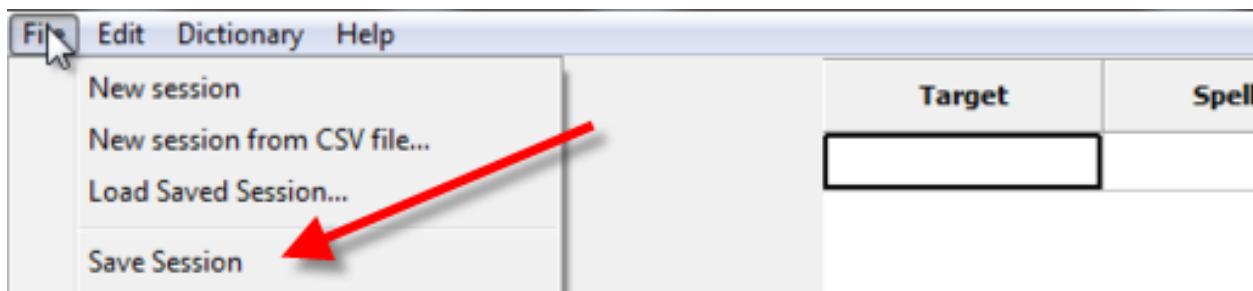
Saving as a CSV file



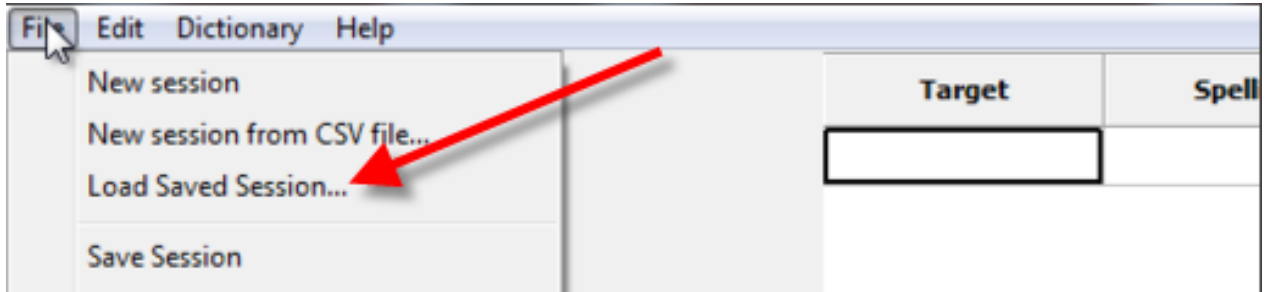
Loading a New Session from CSV file



3. Saving Sessions for Additional Analyses (Save Session): Sessions may be saved and revisited at a later point for further analyses. To **save a session**, select FILE then SAVE SESSION or SAVE SESSION AS, type the desired file name, then select SAVE. Note that the session will be saved in an .SSS Session Files format.



To **retrieve a Saved Session**, select LOAD SAVED SESSION, then retrieve your previously saved file for further analyses.



Parsing and Aligning Spellings with Targets

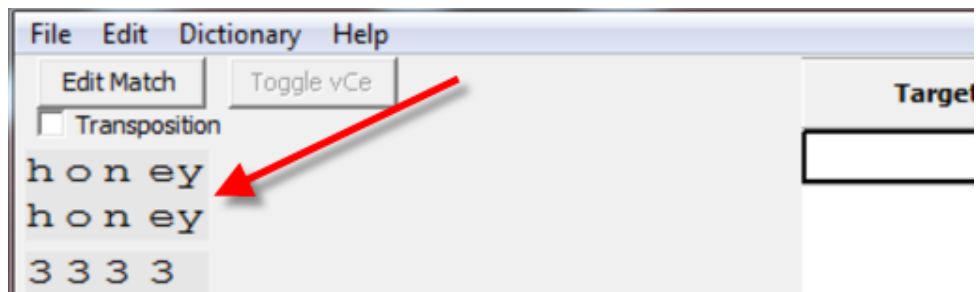
The CSSS performs preliminary parsing of the student’s spellings, and the user inspects each parsing and adjusts if necessary. Following are general principles for parsing student spellings and aligning them with the elements in the target.

1. Align consonant spellings with consonant targets and vowel spellings with vowel targets.
2. Use alignment of vowels as the anchor(s).
3. Focus on spellings as elements, which often consists of vowel combinations (e.g., vowel-consonant-e, vowel pairs) and consonant digraphs or trigraphs (sh, wh, tch).
4. When making decisions about which consonant elements were deleted, consider manner. For example, if *ancient* was spelled as ASHET, the S and H would not be simply aligned with the *n* and the *c*. Instead, SH would be considered an attempt for the target element *ci* because both are representations for the fricative /S/ and the *n* would be considered omitted.
5. Consider Transposition – Transposition is the number of times the spelling error is due to repeating other consonants represented in the word (e.g., KITE spelled as KIKE). If this is suspected, click the Transposition box located under the Edit Match button for the specific entry being analyzed.

Making Adjustments to Parsing and Alignments

First, place your cursor in the row in question and direct your attention to the upper left-hand corner of the screen. You will see that there is a parsed spelling of the target word above the parsed and aligned spelling attempt.

If you agree with the parsing and alignment, move on to the next word. If adjustments are needed, select EDIT MATCH above the target word and align segments by using the spacebar until desired alignment is achieved. Continue this process for the entirety of your data collection.















“Edit” and “Toggle vCe” Buttons

The Edit button located above the target word in the upper left-hand corner may be utilized to adjust alignments of spelling attempts as necessary.

The Toggle vCe button may be used if there is a word that contains a vowel-consonant-e within the aligned spelling. By selecting this button, the system will determine that the vowel before the final consonant was a long vowel due to the added *e* on the end of the attempt. This is important for determining the difference between legal and illegal spellings.

Table 4: Parsing/Aligning Examples and Explanations

Example Number	Target	Participant's Spelling	Spelling Elements				Explanation
1	cat	ct	c	a	t		
			c		t		CT for CAT. The <i>c</i> and <i>t</i> align with the target <i>c</i> and <i>t</i> ; no vowel is represented in the child's spelling.
2	chain	cane	ch	ai	n		
			c	aCe	n		CANE for CHAIN. The <i>c</i> aligns with <i>ch</i> ; the “aCe” pattern aligns with the <i>ai</i> pattern; the <i>n</i> aligns with the <i>n</i>
3	catch	cach	c	a	tch		
			c	a	ch		CACH for CATCH. The <i>c</i> and <i>a</i> match the <i>c</i> and <i>a</i> ; the <i>ch</i> matches <i>tch</i>
4	baby	tbe	b	a	b	y	
			t		b	e	TBE for BABY. The <i>t</i> matches the <i>b</i> ; no vowel matches, the <i>b</i> matches the target <i>b</i> , the <i>e</i> matches the target <i>y</i>

CSSS Output

When parsing and alignment are complete, scores are exported into reports in CSV format, which can then be opened in Excel, SPSS, etc. for additional analyses. A column for each of the following characteristics is included and contains data for each individual spelling (see Figure 4). The headings for each column are defined in Table 5.

Figure 4: Example of exported reports

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Participant	Target	TargetElements	Spelling	SpellingElements	TotalElements	BaseElements	JuncureElements	AffixElements	ElementsOmitted	BaseElementsOmitted	JuncureElementsOmitted	AffixElementsOmitted	ElementsIllegal	BaseElementsIllegal	JuncureIllegal	AffixIllegal	ElementsLegal	BaseElementsLegal	JuncureLegal	AffixLegal	ElementsCorrect	BaseElementsCorrect	JuncureCorrect	AffixCorrect	TotalElementsFor	WordsScore	ElementsScore	Transposition	Syllables	Transparency	Complexity	
2	Spell	stop	stop	stop	stop	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	12	3	3	0	0	0	0

Table 5: Column Definitions

	Scores Report Column Heading	Definition
1	Participant	Individual from whom the sample was collected
2	Target	Target words for spelling
3	Target Elements	Target word parsed into spelling elements
4	Spelling	Spelling attempt of target word
5	Spelling Elements	Spelling parsed into spelling elements
6	Total Elements	Total number of elements in the target word
7	Base Elements	Total number of elements in the base portion of the target word (e.g., happiness -> h a pp i ness)
8	Juncture Elements	Total number of elements in the juncture portion of the target word (e.g., happiness -> h a pp i ness)
9	Affix Elements	Total number of elements in the affixes portion of the target word (e.g., happiness -> h a pp i ness)
10	Elements Omitted	Total number of omitted elements in the spelling attempt
11	Base Elements Omitted	Number of omitted elements in the base portion of the spelling attempt.
12	Junctures Omitted	Number of omitted elements in the juncture portion of the spelling attempt
13	Affixes Omitted	Number of omitted elements in the affix portion of the spelling attempt
14	Elements Illegal	Total number of illegal elements in the spelling attempt
15	Base Elements Illegal	Number of illegal elements in the base portion of the spelling attempt
16	Junctures Illegal	Number of illegal elements in the juncture portion of the spelling attempt
17	Affixes Illegal	Number of illegal elements in the affix portion of the spelling attempt
18	Elements Legal	Total number of legal elements in the spelling attempt
19	Base Elements Legal	Number of legal elements in the base portion of the spelling attempt
20	Junctures Legal	Number of legal elements in the juncture portion of the spelling attempt
21	Affixes Legal	Number of legal elements in the affix portion of the spelling attempt
22	Elements Correct	Total number of correct elements in the spelling attempt
23	Base Elements Correct	Number of correct elements in the base portion of the spelling attempt
24	Junctures Correct	Number of correct elements in the juncture portion of the spelling attempt
25	Affixes Correct	Number of correct elements in the affix portion of the spelling attempt
26	Total Element Points	Total number of overall element points earned in the student's spelling
27	Word Score	The overall classification of the word as correct (3), legal (2), represented but illegal (1), not fully represented (0). The Word Score is equal to the lowest single element score within that word.
28	Element Score	The average element score in the spelling attempt.
29	Transposition	Set to 1 if the user clicked on Transposition when checking student spelling
30	Syllables	Not currently operational in CSSS (this feature could be added to an exported file in Excel)
31	Transparency	Not currently operational in CSSS (this feature could be added to an exported file in Excel)
32	Frequency	Not currently operational in CSSS (this feature could be added to an exported file in Excel)
33	Complexity	Not currently operational in CSSS (this feature could be added to an exported file in Excel)

Useful Metrics

The SSS metrics in the SSS system allows specialists to chart the percentage of spellings used in each category (i.e., omissions, illegal, legal, correct) as demonstrated by various individual attempts. Development would be evidenced by progressing from omissions, to illegal, to legal, to correct spellings. The SSS metrics are more sensitive to developmental changes at the earliest stages of spelling than traditional right/wrong scoring (Masterson & Apel, 2010).

Mean Scores

The *SSS-Elements* (SSS-E) is calculated by dividing the mean element score for each spelling attempt by the total number of spellings in the sample. The *SSS-Words* (SSS-W) is calculated by dividing the word score for each spelling attempt by the total number of spellings in the sample. The SSS-E and SSS-W can be used as dependent measures in inferential statistical analysis (e.g., T-Tests, ANOVA) and measures of effect size.

Because score reports can be exported (see below), they can be imported into statistical packages such as SPSS. Additional measure such as percent affixes correct and percent junctures correct may also be useful.

Spelling Category Frequencies

The SSS-E and SSS-W represent average scores across or within words, so it is possible that collapsing the types of spellings to determine mean scores might sometimes mask potential changes or group differences. Consequently, frequencies of each type of spelling (i.e., correct, legal, illegal, omissions) can be determined and results analyzed with Chi Square.

Table 6: SSS-E and SSS-W scores

Target	Target Elements	Spelling	Spelling Elements	Word Score	Average Element Score
appealing	a p p e a l i n g	appealing	a p p e a l i n g	3	3.00
attached	a t t a c h e d	attacht	a t t a c h t	1	2.60
baby	b a b y	babby	b a b b y	2	2.75
banged	b a n g e d	bangd	b a n g d	1	2.50
bass	b a s s	bas	b a s	2	2.67
better	b e t t e r	beter	b e t e r	2	2.75
bite	b i t e	bit	b i t	1	2.33
blouses	b l o u s e s	blouces	b l o u c e s	1	2.60
bomb	b o m b	bom	b o m	2	2.67
bossed	b o s s e d	bust	b u s t	1	1.50
bottle	b o t t l e	bodaly	b o d a l y	1	2.25
bowl	b o w l	bole	b o l e	1	2.00
bucks	b u c k s	bocks	b o c k s	1	2.50

Report Format

Option 1 – Export Scores

Scores for each word in a target sample are listed on a single row. Consequently, an individual participant's spellings will be displayed across several rows and each spelling will contain 29 columns of corresponding descriptive data.

Select FILE on the toolbar, then EXPORT SCORES. Below is an example of the file that you will receive:

Participant	Target	TargetElements	Spelling	SpellingElements	TotalElements	BaseElements	JunctureElements	AffixElements	ElementsOmitted	BaseElementsOmitted	JunctureElementsOmitted	AffixElementsOmitted	ElementsIllegal	BaseElementsIllegal	JunctureElementsIllegal	AffixElementsIllegal	ElementsLegal	BaseElementsLegal	JunctureElementsLegal	AffixElementsLegal	ElementsScored	BaseElementsScored	JunctureElementsScored	AffixElementsScored	TotalElementsPoints	Wordscore	ElementScore	Transposition	Syllables	Transparency	Frequency	Complexity
1	Spellstop	stop	stop	stop	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	3	0				
3	Spellbed	bed	bed	bed	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	3	3	0					
4	Spelllet	let	let	let	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	3	3	0					
5	Spellplant	plant	plant	plant	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	3	3	0					

Group	Participant	Target	TargetElements	Spelling	SpellingElements	TotalElements	BaseElements	JunctureElements	AffixElements	ElementsOmitted	BaseElementsOmitted	JunctureElementsOmitted	AffixElementsOmitted	ElementsIllegal	BaseElementsIllegal	JunctureElementsIllegal	AffixElementsIllegal	ElementsLegal	BaseElementsLegal	JunctureElementsLegal	AffixElementsLegal	ElementsScored	BaseElementsScored	JunctureElementsScored	AffixElementsScored	TotalElementsPoints	Wordscore	ElementScore	Transposition	Syllables	Transparency	Frequency	Complexity
2	PD	7080-2	in	in	in	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3	PD	7080-2	he	he	he	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
4	PD	7080-2	six	six	six	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5	PD	7080-2	green	green	green	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
6	PD	7080-2	are	are	are	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7	PD	7080-2	was	was	was	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8	PD	7080-2	under	under	under	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
9	PD	7080-2	house	house	house	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
10	PD	7080-2	rain	rain	rain	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
11	PD	7080-2	table	table	table	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4

Option 2 – Export Scores Single Row

Scores for each participant in a target sample are listed on a single row. Because each spelling entry is associated with 29 columns of data, files in this format can consist of hundreds or even thousands of columns. This format may be particularly useful in studies that focus on spelling trends within an individual across words or across time.

1. Select FILE on the toolbar, then EXPORT SCORES SINGLE ROW.

Participant	Target	TargetElements	Spelling	SpellingElements	TotalElements	BaseElements	JunctureElements	AffixElements	ElementsOmitted	BaseElementsOmitted	JunctureElementsOmitted	AffixElementsOmitted	ElementsIllegal	BaseElementsIllegal	JunctureElementsIllegal	AffixElementsIllegal	ElementsLegal	BaseElementsLegal	JunctureElementsLegal	AffixElementsLegal	ElementsScored	BaseElementsScored	JunctureElementsScored	AffixElementsScored	TotalElementsPoints	Wordscore	ElementScore	Transposition	Syllables	Transparency	Frequency	Complexity
2	Spellstop	stop	stop	stop	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

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