
Gaze Annotation Tool

"FixFix"

Instruction Manual

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Last update: December 12, 2015.

Version: 0.0.9

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1. About this Manual

This Instruction Manual¹ describes the basic operation of the "FixFix" gaze annotation tool and presents information on Fixation-to-Word annotation. Feel free to contact the following address in case of any unclear point in this operating guide.

Persons in charge

- | | |
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Acknowledgments

The development of FixFix has been conducted under the support of a Grant-in-Aid for challenging Exploratory Research (Theme number: 26540121) and the National Institute of Informatics of Japan. Moreover, this development has received the cooperation by Prof. Takenobu Tokunaga of Tokyo Institute of Technology and Prof. Michael Carl of Copenhagen Business School.

¹ The contents of this manual are subject to change without notice.

2. Outline

2.1. What is FixFix?

Gaze movement extracted from text reading, which can be utilized to measure the readability of a document and a reader's reading ability, can be applied in various studies. Although eye movement measurement using an eye tracker can provide comparatively high relative accuracy of position, it has insufficient accuracy to distinguish exactly which character is looked at. Therefore a researcher shifts the raw gaze data manually to allocate them to words in a text.

FixFix, a tool developed to annotate such a fixation, can correct errors in eye movement of a reader measured with an eye tracker. An example of alignment by FixFix is presented in Fig. 1.

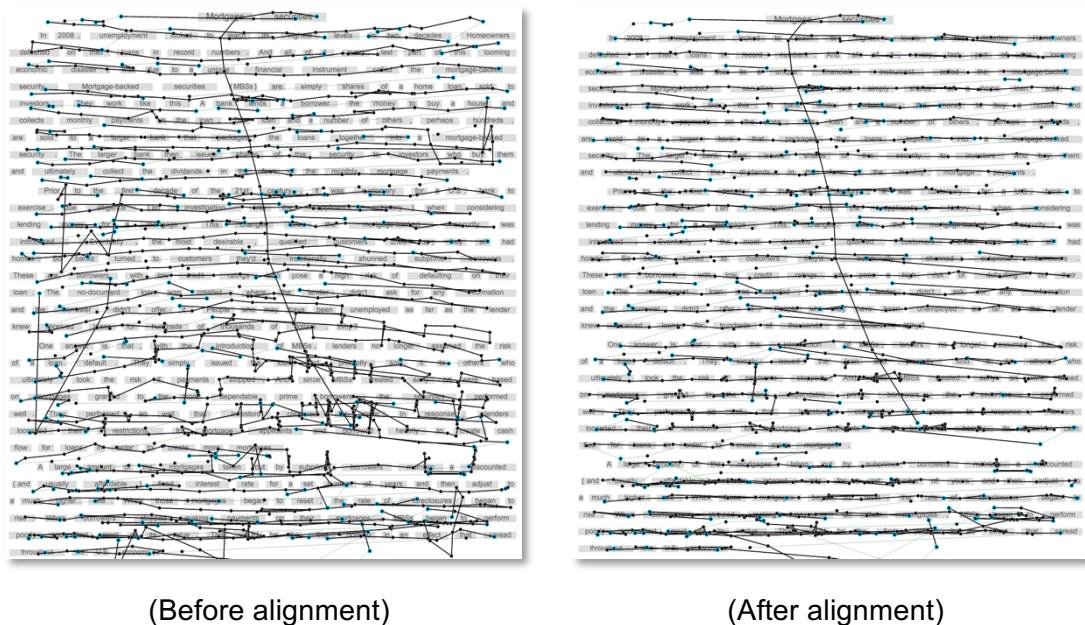


Fig. 1 Alignment example.

2.2. Fixation-to-Word Alignment

It is expected that eye movement obtained by an eye tracker is to be analyzed in combination with a corresponding document that is read. Relating eye movement and a document requires appropriate continuous mapping in time between a fixation and words in a text. This manual refers to this mapping as Fixation-to-Word alignment.

FixFix performs Fixation-to-Word alignment efficiently. Fixation-to-Word alignment is carried out using the following procedures. See Chapter 4 "Data Uploading" and Chapter 5 "How to Operate FixFix" for details of each operation.

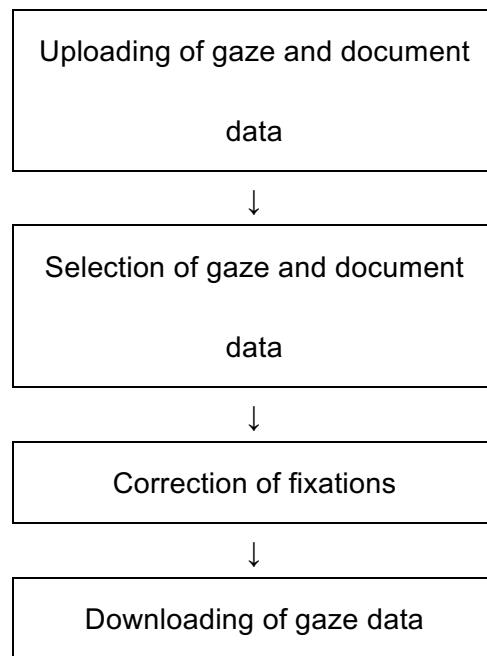


Fig. 2 Operation flow.

3. Installation Procedure

Requisite operating environment

- Ruby 2.0+

1. Install Bundler if not installed.

```
# gem install bundler
```

2. Clone the fixfix repository with Git.

```
# git clone https://github.com/KMCS-NII/fixfix.git
```

3. Move to the fixfix directory.

```
# cd fixfix
```

4. Install necessary libraries.

```
# bundle install
```

5. Execute.

```
# rackup
```

6. Launch FixFix by entering the following into URL of browser ².

```
http://localhost:9292/
```

²We recommend the current version of Google Chrome as a web browser. FixFix might not display results correctly when used with other browsers.

4. Data Uploading

4.1. Uploading Procedure

Data can be uploaded by drag and drop to a file group subwindow at the upper left of the FixFix window from the file system of a PC in use. Multiple files can be uploaded by a single operation, but all the uploaded files must be dropped into the same folder. A folder cannot be uploaded. Right-click the folder group subwindow, choose "New Folder", and input a folder name to add a new folder.

Drop data to file group subwindow: data uploading

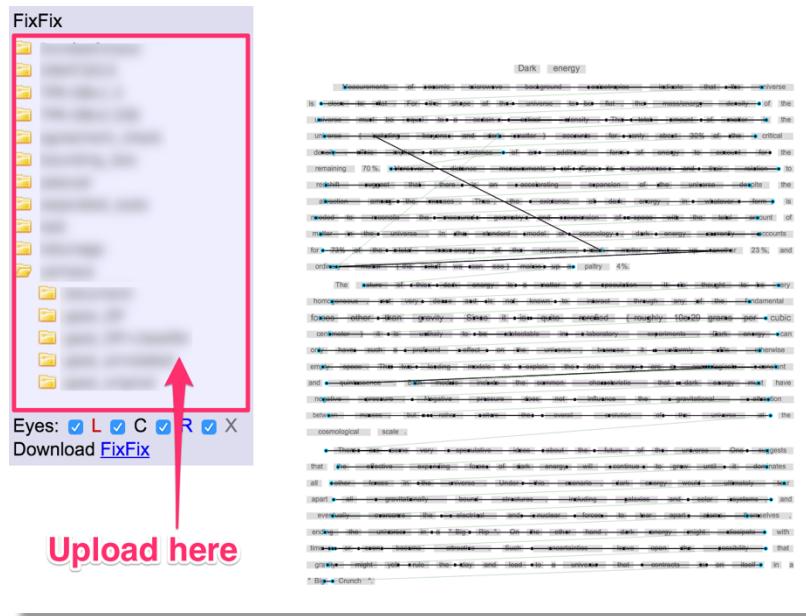


Fig. 3 Uploading of gaze data.

Right-click a filename or a folder name in the file groups and choose "Delete" to delete data.

Right-click a filename or a folder name: data deletion

4.2. Document Data Format

FixFix currently supports the following document data formats.

- .bb: bounding box TSV files.

```
#word    bounding_box  
Gold    602,110,651,132
```

4.3. Gaze Data Format

FixFix currently supports the following gaze data formats.

- .tsv: gaze TSV files.

```
# GazePointLeftX (ADCSpX)      GazePointLeftY (ADCSpX)  
GazePointRightX (ADCSpX)      GazePointRightY (ADCSpX)  
GazePointX (ADCSpX)          GazePointY (ADCSpX)      PupilLeft  
PupilRight      ValidityLeft      ValidityRight      RecordingTimestamp  
932           519           928           465           930           492           2.35  
2.28           0             0             1796
```

- .fixfix: the fixation files produced by FixFix.

```
FixPointLeftX  FixPointLeftY      FixPointRightX      FixPointRightX  
FixPointX  FixPointX  FixDuration      MeanPupilLeft  
MeanPupilRight      ReturnSweep      BlinkTime  
MeanTimestamp      StartTimestamp      EndTimestamp  
575    70        575    70        575    70        169    3.7  
3.84                      1353905989191  1353905989106  
1353905989276
```

5. How to Operate FixFix

5.1. Description of Windows

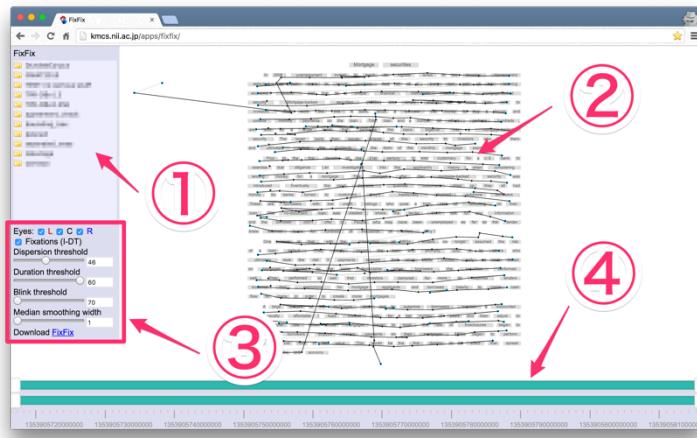


Fig. 4 Operation window.

1. File Group Subwindow

- Selection of gaze data and text data

2. Main Work Window ³

- Shifting and zooming in/out
- Moving gaze data

3. Various Functions ⁴

- Selection of eyes (left eye, center, right eye) for display
- With/without automated identification of a fixation by the I-DT algorithm ⁵
- Tuning of various parameters of the I-DT algorithm
- Downloading of gaze data in .fixfix format.

4. Move Bars

- Upper bar: selection and moving of a highlighted range
- Lower bar: selection and moving of a gaze data range to display

³ Displayed only when gaze data or document data are selected.

⁴ Some functions are expressed only as gaze data (.tsv) obtained by an eye tracker.

⁵ Algorithm that identifies a fixation from observational data.

5.2. Basic Operations

5.2.1. Selection of Data

Select document data (.bb) and gaze data (.fixfix or .tsv) from the file group subwindow on the left-hand side of the screen.

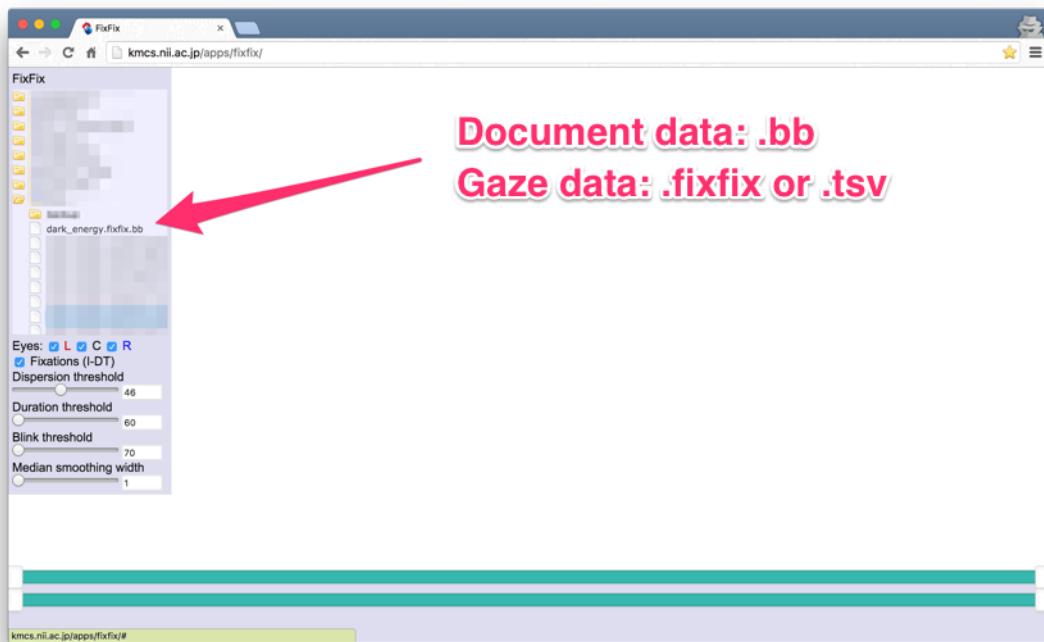


Fig. 5 Selection of data.

5.2.2. Shifting Image and Zooming In/Out

Shift, zoom in, or zoom out a displayed image with a mouse or a trackpad so that it fits the window.

Drag white background: Shifting image

Scroll up/down: Zooming in/out image

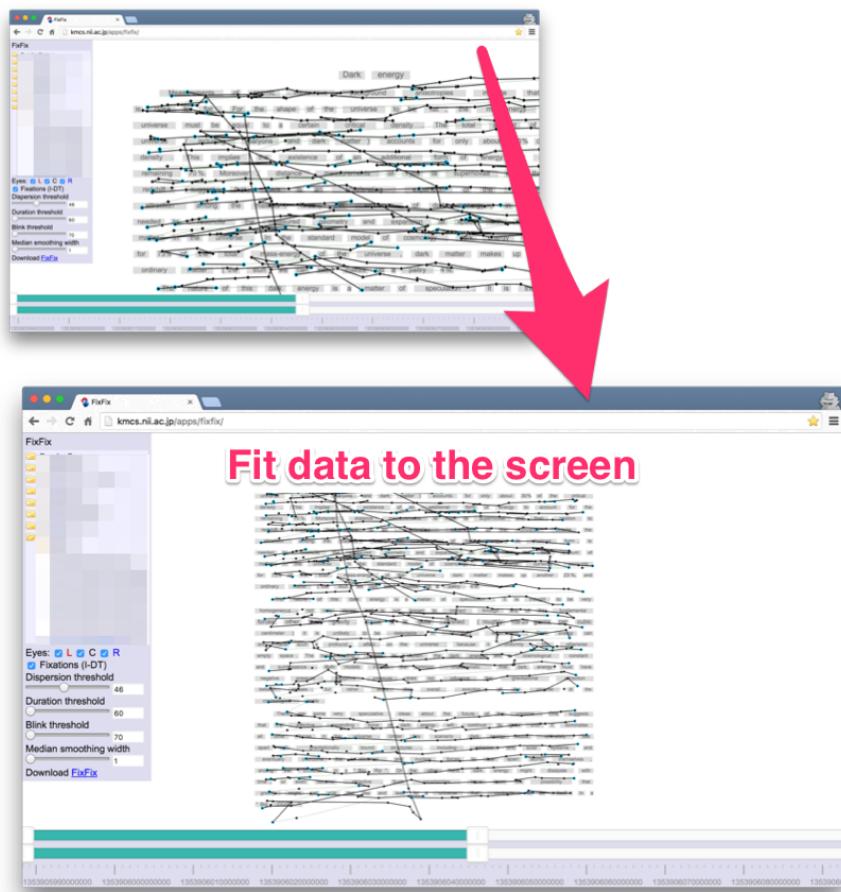


Fig. 6 Screen adjustment.

5.2.3. Moving Gaze Data

Once gaze data and document data are displayed, move the fixations of gaze data. Gaze data are indicated with black points and arrows, where a point and an arrow respectively represent a fixation and saccade. A green thin line expresses saccade in a return sweep, and has a black point surrounded by a blue circle at both ends. This signifies that these points are fixed. Drag a fixation to move gaze data.

- Black point: **Fixation**
- Black arrow between points: **Saccade**
- Green thin line: **Saccade in a return sweep**
- Black point surrounded by blue circle: **Fixed fixation**

Drag a black point: gaze movement

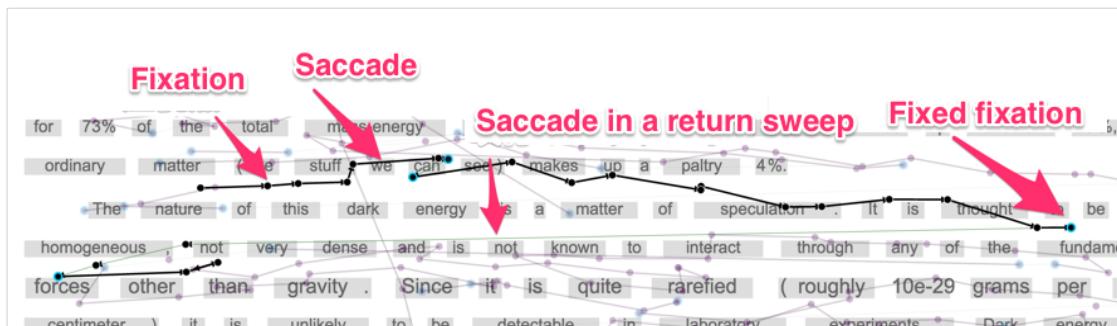


Fig. 7 Gaze data.

5.2.3.1. Single Mode ON

Right-click the background on the screen to display a popup menu. Choose "Single Mode" and confirm a check mark (other functions on this menu are explained later.).

Right-click: Display menu.

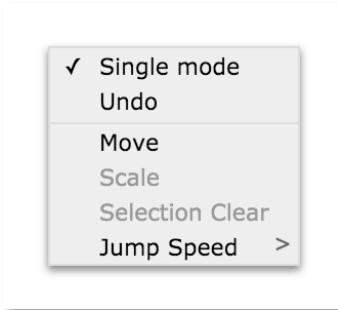


Fig. 8 Menu pops up when right-clicking background.

A single fixation can be dragged and moved at Single Mode ON. This mode is useful when fine operations are necessary or especially when one fixation has only been shifted by blink, etc.

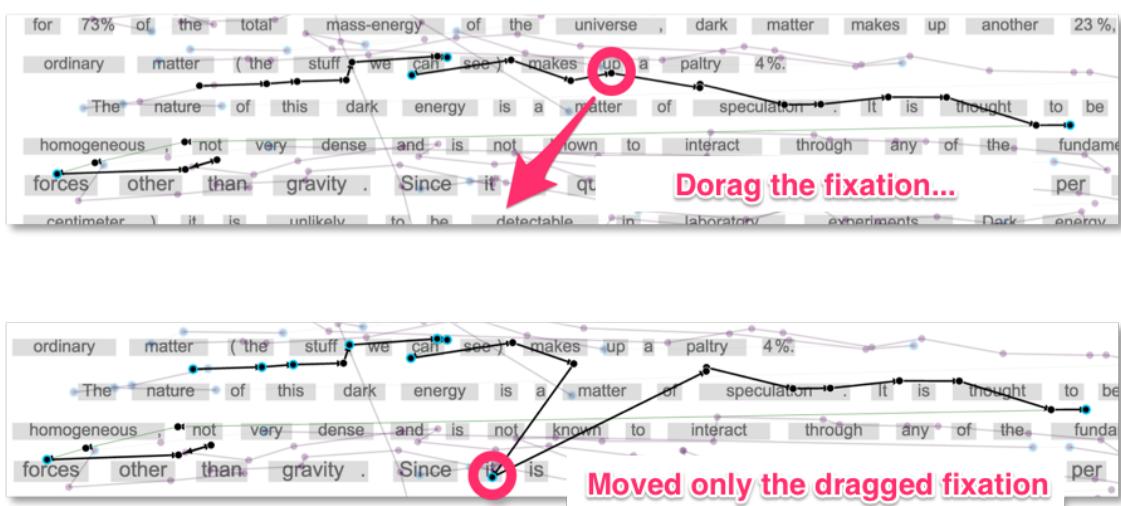


Fig. 9 Motion example at Single Mode ON.

5.2.3.2. Single Mode OFF

Multiple fixations are moved simultaneously at Single Mode OFF. All fixations on a gaze path divided by saccades in a return sweep (or divided by fixed points, if any) are moved together as a moving object. This mode is useful especially in case of incorrect calibration before measurement or when the whole gaze path is slant by head shaking during measurement.

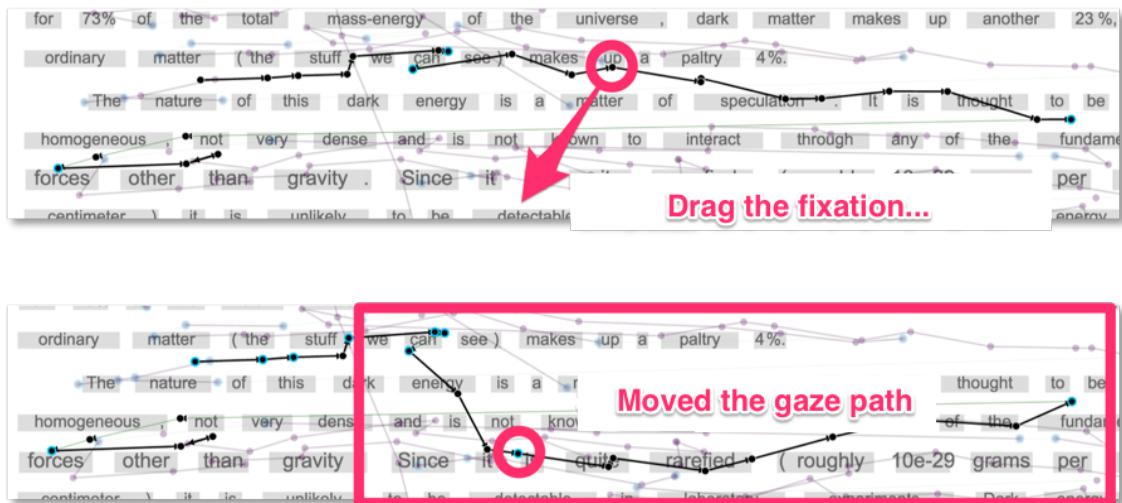


Fig. 10 Motion example at Single Mode OFF.

5.2.4. Specification of Highlighted Range

Right-click a fixation to display a pop-up menu shown in Fig. 11. Choose two arbitrary points and set them to "Selection Start" or "Selection End" to highlight fixations only between the two selected points.

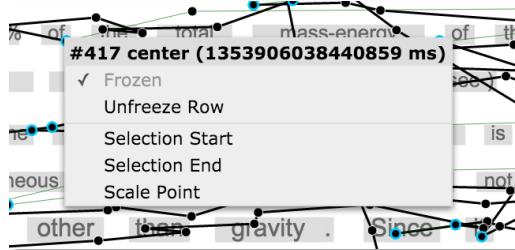


Fig. 11 Menu when fixation is right-clicked.

Highlighting allows a user to concentrate only on the fixations in a place to work, and prevents moving other fixations accidentally. A highlighted range can be shifted with arrow keys.

Arrow keys (\leftarrow , \rightarrow): shifting highlight range

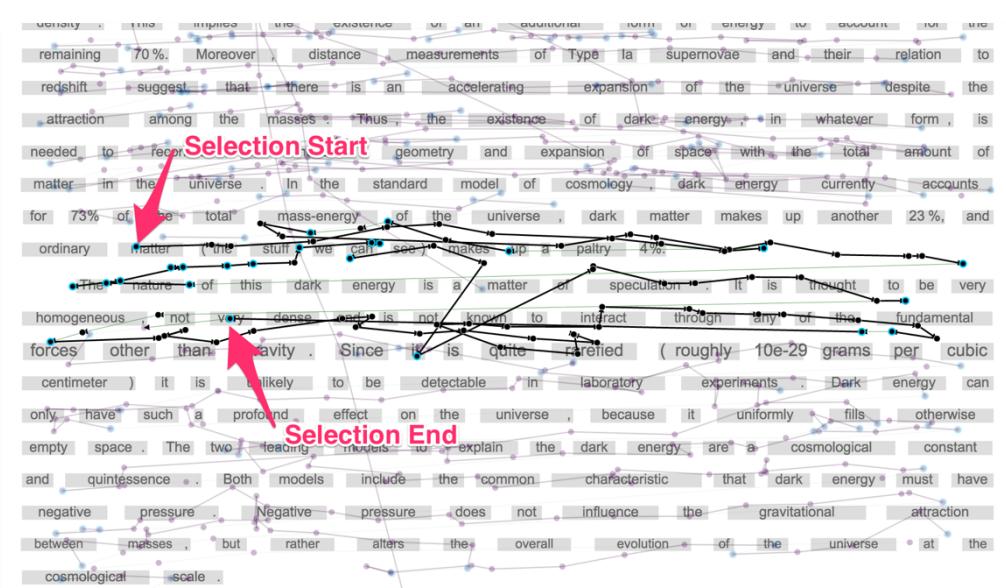


Fig. 12 Specification of highlighted range.

5.2.5. Downloading of Gaze Data

Corrected gaze data can be saved in .fixfix format. Click "Download FixFix" in the subwindow on the left-hand side of the screen to save, otherwise push the "Scrap changes" button to cancel all modifications and to restore to original state immediately after uploading.

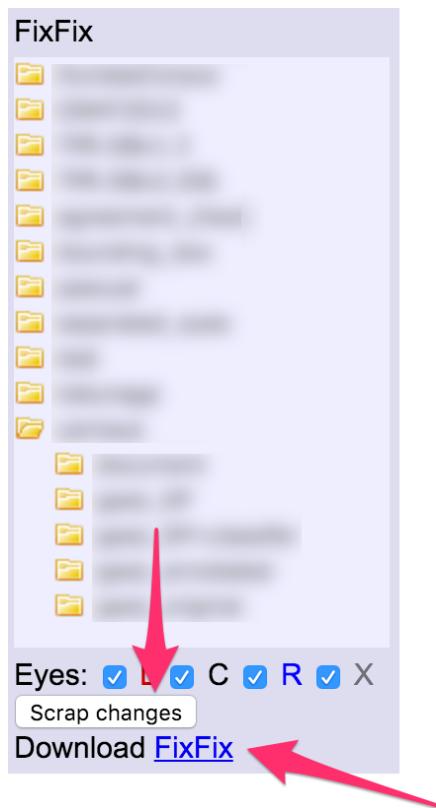


Fig. 13 Downloading and cancellation of modification.

5.3. Advanced Operations

5.3.1. Parameter Tuning in I-DT Algorithm

Parameters in the I-DT algorithm can be tuned only when gaze data are given in **.tsv** format. A parameter can be modified by moving a bar or entering a value into a text box.

Moving bar or entering number: parameter tuning in the I-DT algorithm.



Fig. 14 Parameter tuning.

5.3.2. Collective Move of Fixation Block

When whole gaze data have been shifted to a certain direction because of incorrect calibration before measurement, a range to be collected can be specified and a block of fixations in the division can be moved simultaneously.

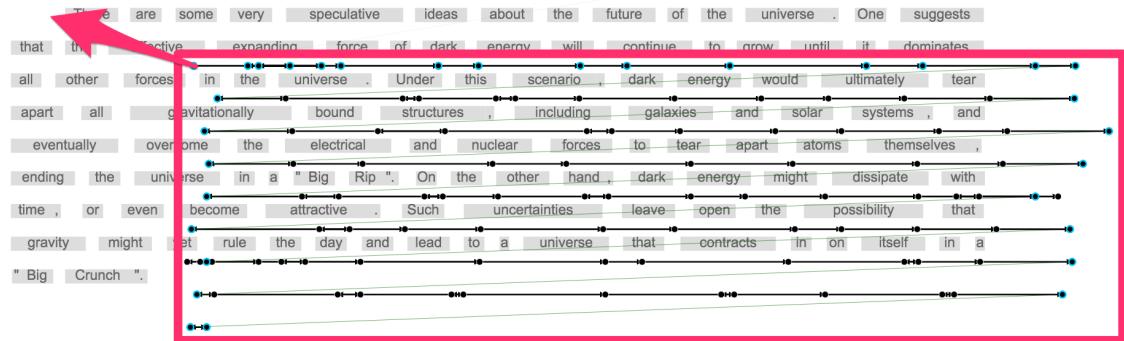


Fig. 15 Move a block of fixations simultaneously.

<Procedure>

1. Designate fixations to be moved together with "Selection Start" and "Selection End." Only the selected area is highlighted.
2. Right-click one arbitrary fixation in the designated range; choose "Scale Point."
3. Move the fixation designated as a "Scale Point" to the desired position.
4. Right-click the background on the window; choose "Move." Then all the fixations in the selected range move along with the fixation designated by the Scale Point.

5.3.3. Reference-Assisted Annotation

Gaze data with automated correction of fixation position might be utilized as a reference in the event of annotation in the aim of reducing the loads of annotation. Note that such gaze data subjected to automated position correction must be prepared separately.

<Procedure>

1. Prepare gaze data and document data according to 5.2.1 and 5.2.2.
2. Select gaze data⁶ to be used as a reference by right-click from the file group subwindow on the left hand side of the screen; choose "Load Reference."

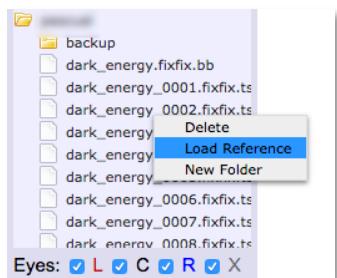


Fig. 16 Selection of reference data.

3. Gaze data with automated position correction are displayed on the screen as tiny points. Correct the position of fixations in reference to this. More efficient annotation is attained by combining and using this technique with specifications of a highlighted range in 5.2.4.

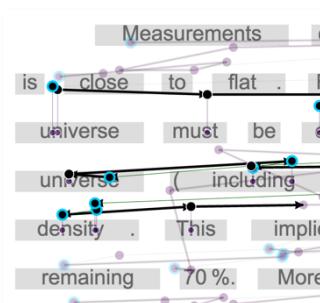


Fig. 17 Reference-assisted annotation.

⁶ Gaze data for annotation and those for reference must be gaze data acquired by reading the identical document by the identical subject (the time stamp of each fixation must be shared).

6. Alignment Examples

The following three cases explain examples of position gap errors of fixations to be corrected and correction parts in Fixation-to-Word alignment.

1. A gaze path tilts aslant.
2. A gaze path is shifted by one or more lines.
3. A gaze deviates at only one certain point.

6.1. Slant Gaze Path

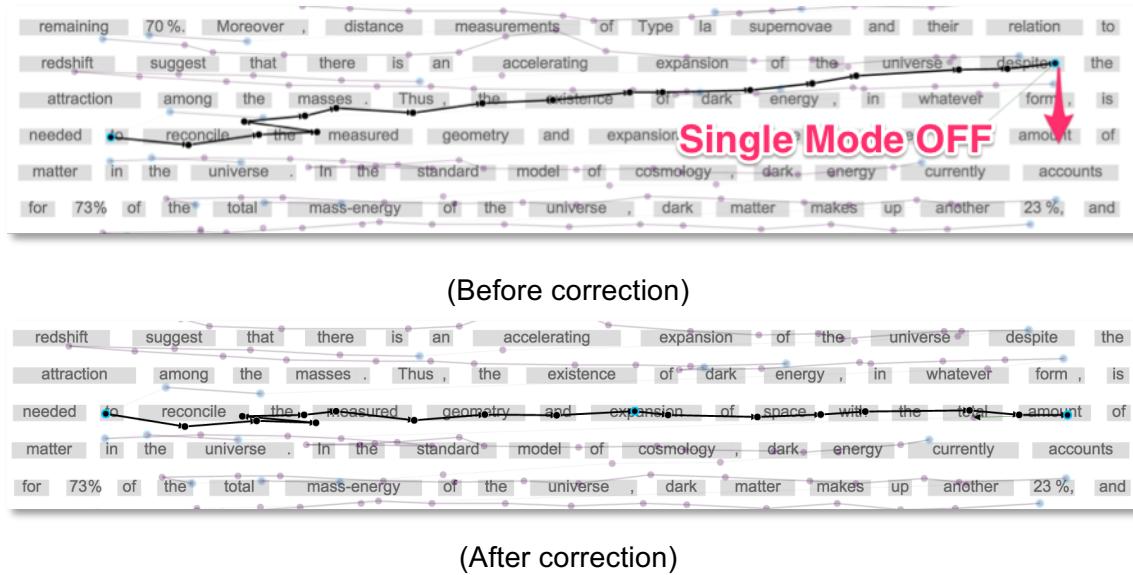


Fig. 18 Gaze path tilts aslant.

6.2. Shift by One or More Lines

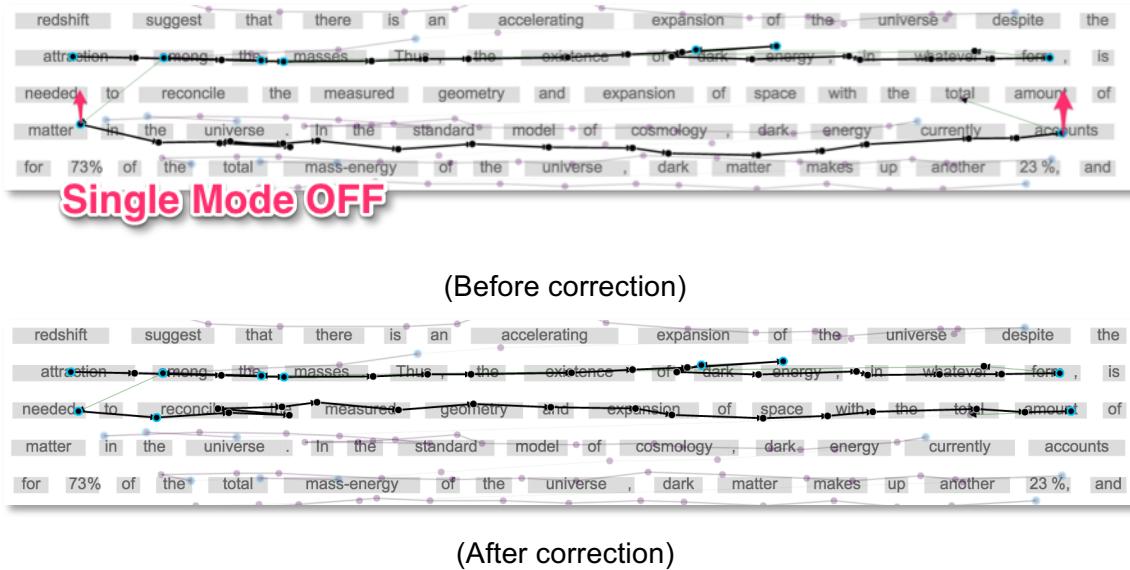


Fig. 19 Gaze path is shifted by one or more lines.

6.3. Gaze Deviation at Only One Point.

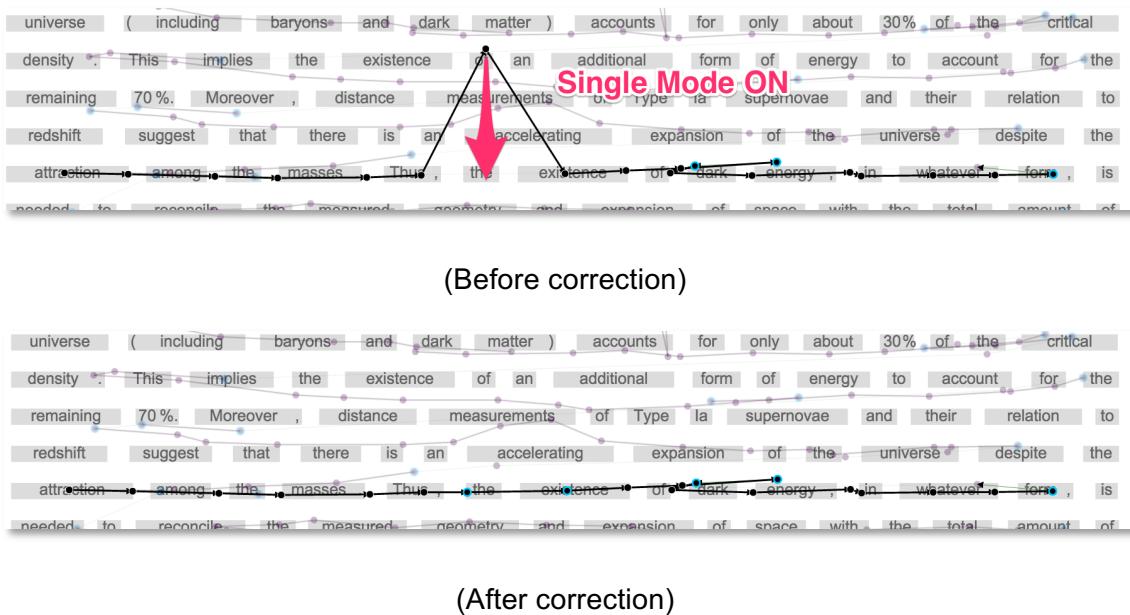


Fig. 20 Gaze deviates at only one certain point.

7. Useful Tips for Operation

7.1. Use of Replay Function of Gaze Movement

As preliminary arrangements for Fixation-to-Word alignment, follow a gaze path using an arrow key from the start to end of gaze data highlighting each line. Then you can capture gaze data sequentially and acquire information such as "Here is the end of a paragraph." or "Here starts a return sweep."

7.2. Paragraph End as a Clue

When you cannot determine to which line a certain gaze path should be moved, replay the movement of a gaze described above. Then a gaze can be aligned with the end line of a paragraph as a clue. For example, if a short gaze path corresponding to the end line of a paragraph has been shifted one line below, then other lines can also be assumed to have shifted one line below.

7.3. Convenient Shortcuts

- Undo (Command (Ctrl) +Z)

The last moving operation of a fixation can be canceled similarly to an undo function provided with many applications.

- Cancel gaze movement (Esc)

When dragging a fixation with a mouse, the selection can be canceled by pressing the Esc key.

- Switch ON/OFF of Single Mode (Space)

ON and OFF of Single Mode can be toggled by the space key.

8. Frequently Asked Questions (FAQ)

8.1. Screen Blanking by Mouse Wheel Movement

Such symptoms have been reported mainly on Windows OS. Check the scroll rate of a mouse wheel from the configuration of your PC.

8.2. Selected Range Not Shifted by Cursor Key after Highlighting.

Jump Speed might not be configured properly. Right-click the background on the screen, display a pop-up menu, and increase Jump Speed. In cases of a specific gaze data file, it is known that a fixation does not move at 500 ms but at 200,000 ms.

8.3. Unmovable Fixations

Fixation between thin green lines on the screen cannot be moved because FixFix has judged this as a fixation during a return sweep (that is, no word is gazed at).

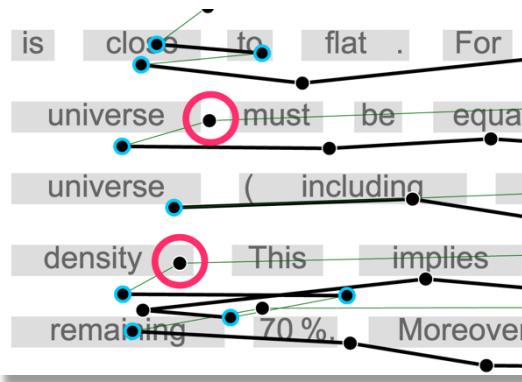


Fig. 21 Fixation in a return sweep.

9. References

- [1] Yamaya, A., Topić, G., Martínez-Gómez, P., & Aizawa, A. (2015). Dynamic-Programming-Based Method for Fixation-to-Word Mapping. In Intelligent Decision Technologies (pp. 649-659). Springer International Publishing.

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