

# Package ‘fpa’

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**Type** Package

**Title** Spatio-Temporal Fixation Pattern Analysis

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**Description** ``Spatio-temporal Fixation Pattern Analysis" (FPA) is a new method of analyzing eye movement data, developed by Mr. Jinlu Cao under the supervision of Prof. CHEN Hsuan-Chih at the Department of Psychology, The Chinese University of Hong Kong, and Prof. Wang Suiping at the School of Psychology, South China Normal Univeristy. The package ``fpa" is a R implementation which makes FPA analysis much easier. There are four major functions in the package: ft2fp, get\_pattern, plot\_pattern, and lineplot. The function ft2fp is the core function, which can complete all the preprocessing within seconds or minutes. The other three functions are supportive functions which visualize the eye fixation patterns.

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**License** GPL-2

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fpa-package*Spatio-temporal Fixation Pattern Analysis*

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## Description

"Spatio-temporal Fixation Pattern Analysis" (FPA) is a new method of analyzing eye movement data, developed by Mr. Jinlu Cao under the supervision of Prof. CHEN Hsuan-Chih at the Department of Psychology, The Chinese University of Hong Kong, and Prof. Wang Suiping at the School of Psychology, South China Normal University. The method provides a new way to inspect the spatio-temporal fixation patterns of eye movements.

## Details

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Type: Package  
Version: 1.0  
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The package "fpa" is a R implementation which makes FPA analysis much easier. There are four major functions in the package: `ft2fp`, `get_pattern`, `plot_pattern`, and `lineplot`. The function `ft2fp` is the core function, which can complete all the preprocessing within seconds or minutes. The other three functions are supportive functions which visualize the eye fixation patterns.

## Author(s)

Jinlu Cao

Maintainer: Jinlu Cao <caojinlu@gmail.com>

## See Also

[ft2fp](#), [get\\_pattern](#), [plot\\_pattern](#), [lineplot](#)

## Examples

```
data(rawdata)
newdata <- ft2fp (rawdata, 4, 3000, 100)
pattern <- get_pattern(newdata)
plot_pattern(pattern)
```

---

ft2fp*Convert fixation time to fixation probability*

---

## Description

The ft2fp function transforms the fixation time (start and end time for each fixation) data to fixation probability data. The function can finish all the preprocessing of using FPA to analyze eye movement data. Users should provide the fixation time data, the critical region number, the intended time course of interest, and the intended time interval. The user can also adjust the results by input other requests like if the user wants to normalize fixation durations, if the user wants to exclude the trials with no regression, and if the user wants to exclude the information on first pass on critical region.

## Usage

```
ft2fp(data,CriticalRegion,TimeCourse,TimeInterval,Normalize=TRUE,ExcludeNoRegress=FALSE,ExcludeFirstPass=FALSE)
```

## Arguments

|                  |  |
|------------------|--|
| data             | the raw eye movement data provided by user. It is a data frame which contains variables of "List", "Subject", "Item", "Condition", "Region", "Fix_Start", and "Fix_End". The names and number of variables in your data should be exactly same with above. |
| CriticalRegion   | the No. of region in which the researcher is interested. All fixation information before the first-pass on that region will be discarded for each trial.   |
| TimeCourse       | the time course to be analyzed after the first-pass of critical region. The unit is millisecond.   |
| TimeInterval     | the time interval (or bin) to show in the time course of interest. The unit is millisecond, and the value should be smaller than the value for TimeCourse.   |
| Normalize        | to choose whether to normalize the fixation duration according to each subject's mean duration and general mean duration. When Normalize is TRUE, the fixation durations are adjusted for each subject's reading rate. The default value is TRUE.          |
| ExcludeNoRegress | to choose whether to exclude the trials with no regression after the first-pass on critical region. The default value is FALSE.  |
| ExcludeFirstPass | to choose whether to exclude the fixations at the first pass (or Gaze duration) on critical region. The default value is TRUE.   |

## Value

a data frame with the variables of "list", "subject", "condition", "region", "time", "fix\_prob" (fixation probability), "y" (number of trials with fixation) and "N" (number of total valid trials).

## Author(s)

Jinlu Cao

## See Also

[fpa](#)

## Examples

```
data(rawdata)
newdata <- ft2fp (rawdata, 4, 3000, 100)
newdata <- ft2fp (rawdata,4,3000,100,Normalize=TRUE,ExcludeNoRegress=TRUE,ExcludeFirstPass=FALSE)
```

---

|             |   |
|-------------|---|
| get_pattern | <i>Get the general fixation pattern</i> |
|-------------|---|

---

**Description**

The `get_pattern` function aggregates the data so that the general fixation pattern can be shown for each condition. Users should provide the data frame returned in `ft2fp` function. Users can use the returned data frame of this function to make plots on the pattern by themselves, or use `plot_pattern` and `lineplot` functions.

**Usage**

```
get_pattern(data)
```

**Arguments**

`data` is the data frame returned by the `ft2fp` function.

**Value**

a data frame which shows the avraged fixation probabilities for each spatio-temporal unit for each condition.

**Author(s)**

Jinlu Cao

**See Also**

[ft2fp](#), [plot\\_pattern](#), [lineplot](#)

**Examples**

```
data(newdata)
pattern <- get_pattern(newdata)
```

---

|          |   |
|----------|---|
| lineplot | <i>Plot the fixation probabilities for specific details</i> |
|----------|---|

---

**Description**

The function `lineplot` provides quick tools for plotting more detailed fixation probabilities for specific condition(s) and region(s). The function generates 2-dimensional line plots with "Time" as x, and "Fixation Probability" as y.

**Usage**

```
lineplot(data, Region = "All", Condition = "All")
```

**Arguments**

|           |   |
|-----------|---|
| data      | is the data frame returned by <code>get_pattern</code> function.  |
| Region    | is the intended region(s) to plot. It can be a string ("All"), a number (e.g., 1), or a vector (e.g., <code>c(1,2)</code> ).    |
| Condition | is the intended condition(s) to plot. It can be a string ("All"), a number (e.g., 1), or a vector (e.g., <code>c(1,2)</code> ). |

**Author(s)**

Jinlu Cao

**See Also**

[get\\_pattern](#), [ft2fp](#), [plot\\_pattern](#)

**Examples**

```
data(pattern)
lineplot(pattern)
lineplot(pattern, Region="All", Condition=1)
lineplot(pattern, Condition=c(1,2))
lineplot(pattern, Region=2)
lineplot(pattern, Region=c(2,3), Condition=c(3,4,5))
```

---

newdata

*Fixation probability data generated by ft2fp function*


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**Description**

This data set is the fixation probability data generated by the `ft2fp` function. The data set retains the information of list, subject, and condition of original fixation time data set. The variable "Time" is generated based on the `TimeCourse` and `TimeInterval` arguments defined by users. The variable "N" is the total number of valid trials after the deletion of invalid ones for the corresponding spatio-temporal unit. The variable "y" is the number of trials with fixations on that particular region at that time point. Fixation probability is calculated by dividing y by N. "N" and "y" would be used for further analysis in empirical logistic transformation and lme modeling.

**Usage**

```
data(newdata)
```

**Format**

In the data frame each row represents the fixation probability and other information for one spatio-temporal unit. The data frame has the following columns:

```
list    the id of the list
subject the id of the subject
condition the id of the condition
region  the id of the region
```

Time the time after eyes leave critical region

N total number of valid trials

y number of trials with fixations

fix\_prob the fixation probability

---

pattern

*Summary of fixation pattern generated by get\_pattern function*

---

### Description

This data set is generated by `get_pattern` function, and describes the general fixation pattern for different conditions. The values under time variables are the aggregated fixation probabilities for each spatio-temporal unit. Users may use the data set to make plots of the pattern by themselves or use the dataset as argument of `plot_pattern` and `lineplot` functions.

### Usage

```
data(pattern)
```

### Format

The data set aggregates the fixation probability data, and show the general fixation pattern. The data frame has the following core columns:

condition the id of the condition

region the id of the region

0 averaged fixation probability at time 0

2500 averaged fixation probability at time 0

---

plot\_pattern

*Plot the general fixation pattern*

---

### Description

The `plot_pattern` function provides a quick tool to plot the fixation pattern for conditions. It generates 3-dimensional data, with x of "Time", y of "Region", and the colors representing the value of fixation probabilities.

### Usage

```
plot_pattern(data, Condition = "All")
```

### Arguments

data is the data frame returned by the `get_pattern` function.

Condition is the conditions which the user would like to plot. It can be a string ("All"), a number (e.g., 1), or a vector (e.g., c(1,2)). The default value is "All", meaning all conditions will be plotted.

**Author(s)**

Jinlu Cao

**See Also**[get\\_pattern](#), [ft2fp](#)**Examples**

```
data(pattern)
plot_pattern(pattern)
plot_pattern(pattern, Condition=1)
plot_pattern(pattern, Condition=c(1,2))
```

---

rawdata*Fixation time data of an eye movement experiment*

---

**Description**

This data set is the eye movement data recorded during reading sentences. The sentences consists of 8 regions defined by the researcher. The experiment consists of 4 lists (8 items in each list), 23 subjects, and 4 conditions. Each row contains the information of one fixation. This data frame is a template for the data to be provided by users of fpa-package, and the number and names of variables should be same with this data frame. If the user does not have several lists in his/her experiment, please use the id 1 for every row.

**Usage**

```
data(rawdata)
```

**Format**

In the data frame each row represents one fixation of the eyes. Fixations are ordered chronologically within trial. The data frame has the following columns:

List the id of the list

Subject the id of the subject

Condition the id of the condition

Item the id of the item

Region the id of the region being fixed on

Fix\_Start the start time of the fixation

Fix\_End the end time of the fixation

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