

# Package ‘BIOWELL’

July 11, 2023

**Title** Create BIO-WELL Surveys in Shiny to Investigate the Wellbeing Effects From Biodiversity

**Version** 1.0

**Description** The BIO-WELL scale provides a tool for assessing the contribution of biodiversity to human wellbeing. It was developed by Irvine et al. (2023) as part of the interdisciplinary RELATE project, funded by the European Research Council. The BIOWELL package includes functions for developing a survey that uses the BIO-WELL scale and is tailored to your research context and aims. This customised survey is generated as an R Shiny App, which can be deployed onto the Shiny Server for distribution to participants via the internet. Participant responses to your custom BIO-WELL survey are then remotely stored on Dropbox, and the package provides functions for importing, evaluating and analysing your survey response data. We include extensive vignettes and examples for all functions within the BIOWELL package to facilitate the development and deployment of your BIO-WELL survey. Methods used in the package refer to Irvine et al., (2023) <doi:10.1016/j.jenvp.2022.101921>.

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shinytitle,  
htmltools (>= 0.5.4),  
http (>= 1.4.4),  
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shinyFeedback,  
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magrittr,  
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graphics,  
utils,  
rsconnect

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R topics documented:

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activate_dropbox	<i>Activate Dropbox access token</i>
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Description

Function to generate a long-lived Dropbox access token for BIO-WELL survey Shiny App.

Usage

```
activate_dropbox(  
  Dropbox_App_Name,  
  Dropbox_App_Key,  
  Dropbox_App_Secret,  
  BW_app_path  
)
```

Arguments

- Dropbox\_App\_Name  
a character string, the name given to your Dropbox App.
- Dropbox\_App\_Key  
a character string, the Dropbox App Key. See details for more information.
- Dropbox\_App\_Secret  
a character string, the Dropbox App Secret. See details for more information.
- BW\_app\_path  
a character string, the path to your BIO-WELL Shiny App folder. See details for more information.

## Details

When your BIO-WELL survey Shiny App is hosted on the [Shiny Server](#), you will need to save participant responses to a remote [Dropbox folder](#).

First, you must register for a free Dropbox account. Then, to generate a long-lived access token (over four hours) for your BIO-WELL survey, you will need to set up a Dropbox App within your Dropbox account. It is important that certain Dropbox App settings are edited before running `activate_dropbox()`, including:

- Under "OAUTH2: Redirect URIs" add "http://localhost:1410/"
- Under "Permissions" tick for access to Dropbox folder to read and write files.

Full details on completing these changes are detailed in Vignette 1 within the `BIOWELL` package. Then you can generate your Dropbox App's Key and Secret in the settings tab.

Once you have created a Dropbox App, the details (name, Key and Secret) can be plugged into `activate_dropbox()`, alongside the path to your BIO-WELL survey Shiny App folder (argument `BW_app_path`). This is a folder that you need to create on your local computer for storing your BIO-WELL survey code (as an R script entitled "app.R") and the Dropbox token (automatically done by `activate_dropbox()`) for upload to the Shiny Server.

This function will generate a long-lived, refreshable Dropbox access token and store it within a ".secrets" folder within your BIO-WELL survey Shiny App folder. This enables the token to be accessible whilst hosted on the Shiny Server.

Please see Vignette 1 in the `BIOWELL` package for full guidance on this function.

## Value

Saves a long-lived Dropbox token to your BIO-WELL survey Shiny App folder.

## Examples

```
BW_app_path <- paste0(tempdir(), "/my_app_name_1")

dir.create(BW_app_path) # Create App directory to store token

activate_dropbox(Dropbox_App_Name = "my_app_name_1",
                 Dropbox_App_Key = "your_app_key_here",
                 Dropbox_App_Secret = "your_app_secret_here",
                 BW_app_path = BW_app_path)
```

---

build\_survey

*Create BIO-WELL survey in Shiny*

---

## Description

Function to generate custom BIO-WELL survey with R Shiny

## Usage

```
build_survey(
  survey_title = NULL,
  sidepanel_message = NULL,
  organisation,
  organisation_website = NULL,
  screen_message = NULL,
  screen_questions,
  screen_questions_ID,
  screen_response_options = NULL,
  start_message = NULL,
  start_questions,
  start_questions_ID,
  start_questions_type,
  start_response_options = NULL,
  biowell_setting,
  biowell_setting_ID,
  biowell_questions,
  biowell_questions_ID,
  end_message = NULL,
  end_questions,
  end_questions_type,
  end_questions_ID,
  end_response_options = NULL,
  all_questions = TRUE,
  all_sliders = TRUE,
  user_report = TRUE,
  language = "english",
  offline_mode = FALSE,
  return = "run",
  Dropbox_App_folder,
  BW_app_path
)
```

## Arguments

**survey\_title** a character string, the title of the survey to display on each page.

**sidepanel\_message** a character string, the text to display on the side panel throughout the survey.

**organisation** a character string, the name of the organisation running the survey.

**organisation\_website** a character string, the web address for the organisation running the survey.

**screen\_message** a character string, the text to display above the screening questions.

**screen\_questions** a character string or vector, the text for each screening question.

**screen\_questions\_ID** a character string or vector equal to the length of **screen\_questions**, providing short IDs for each screening question to use in output survey response data frame.

screen_response_options	a list the length of screen_questions with each element containing a vector of choices for responding to each screening question in-turn. To specify which answers to screen by add ":SCREEN" to the option. See details for an example.
start_message	a character string, the text to display above the "start" questions.
start_questions	a character string or vector, the "start" questions to ask participants prior to the BIO-WELL questions.
start_questions_ID	a character string or vector equal to the length of start_questions, providing short IDs for each "start" question to use in output survey response data frame.
start_questions_type	a character string or vector, the type of response item for each "start" question. Length must be equal to the length of start_questions. One of; text, checkbox, selectbox, likert_five and likert_seven. See details for more information.
start_response_options	a list of character strings or vectors, the options to offer for each start_questions of type checkbox or selectbox. Provide these in the same order as they appear in start_questions.
biowell_setting	a character string or vector, describing the environmental space setting(s) for BIO-WELL questions.
biowell_setting_ID	a character string or vector the length of biowell_setting, the short IDs for each BIO-WELL environmental space setting to use in output survey response data frame.
biowell_questions	a list of character strings or vectors, the questions for each separate biowell_setting. Each will be accompanied by the BIO-WELL response item comprising five sliders.
biowell_questions_ID	a character string or vector equal to the length of biowell_questions, the short IDs for each BIO-WELL question to use in output survey response data frame.
end_message	a character string, the text to display above the "end" questions.
end_questions	a character string or vector, the questions to ask participants following the BIO-WELL questions.
end_questions_type	a character string or vector, the type of response item for each "end" question. Length must be equal to the length of start_questions. One of; text, checkbox, selectbox, likert_five and likert_seven. See details for more information.
end_questions_ID	a character string or vector equal to the length of end_questions, providing short IDs for each "end" question to use in output survey response data frame.
end_response_options	a list of character strings or vectors, the options to offer for each end_questions of type checkbox or selectbox. Provide these in the same order as they appear in end_questions.
all_questions	a logical, indicating whether all "start" and "end" questions must be answered to continue with the survey.

all_sliders	a logical, indicating whether all BIO-WELL sliders must be moved at least once to continue with the survey.
user_report	a logical, indicating whether to generate a BIO-WELL score report for participants. See details for more information.
language	a character string, the language for the BIO-WELL sliders. See details for all 31 language options available. Default; english.
offline_mode	Optional; a logical, indicating whether to upload survey response data to Dropbox.
return	optional; whether to run the survey Shiny app or return app component. One of; run, ui, server. Default: run.
Dropbox_App_folder	a character string, the path to the folder in your Dropbox App to save survey responses to.
BW_app_path	a character string, the path to your BIO-WELL survey Shiny App folder. See details for more information.

### Value

Generates a custom BIO-WELL survey in Shiny.

### BIO-WELL survey structure

- Screening: This section allows you to set questions where certain responses will prevent users from completing the survey. For instance, if they are not of a certain age, or do not consent to their involvement.
  - Start: This section allows you to set questions that come before the BIO-WELL questions. For example, these may be generic questions, such as gaining information on a participant's location, gender or employment.
  - BIO-WELL: The questions in this section are all accompanied by the five sliders that comprise the BIO-WELL scale. For each environmental space setting given, a new page is added to the survey. See Irvine et al., (2023) for more details on the BIO-WELL scale and survey set-up, including the BIO-WELL stem questions.
1. biowell\_setting: Text for describing an introductory scenario to cognitively situate the participant within a particular natural environment (i.e. a nearby forest).
  2. biowell\_questions: A list the length of biowell\_setting, in which each element contains a vector of the questions to be asked for each environmental space setting. These stem questions are asked about biodiversity metrics (e.g. abundance, species diversity), as well as biodiversity attributes (e.g. smells, colours, shapes) within each biowell\_setting given.
- End: This section allows you to set questions that follow the BIO-WELL questions. This may include asking participants for their contact details or questions that may help understand patterns in BIO-WELL scores, such as whether individuals spend a lot of time outdoors.
  - Report: This section will calculate the participant's average BIO-WELL score across the five wellbeing domains in the BIO-WELL scale (physical, emotional, cognitive, social and spiritual) and provide users with an interpretation of their BIO-WELL score, including a comparison to previous survey participants.

**Structure: messages, questions, IDs, types and options.**

Each section can be specified using arguments relating to the following aspects:

**Messages:**

Text that will accompany each section or display throughout the survey.

**Questions and IDs:**

Questions provide the exact text for each question to ask participants.

IDs provide shorted versions or codes for each question within the survey. These are then used in the output survey response data frame to prevent lengthy column names. For example, the question "The variety of textures in this forest makes me feel..." could be given the ID "Variety of textures".

**Response types and options:**

There are five response type options to accompany non-BIO-WELL questions. These include:

1. `text` - A simple text box that the participant can type their answer into.
2. `selectbox*` - A drop-down box that the participant can choose one answer from.
3. `checkbox*` - A group of checkboxes that the participant can choose multiple or none of. Be aware that if `all_questions = TRUE`, participants will have to select one of the check boxes, and so it is best to include an option for selecting none of the other options.
4. `likert_five` - A five point Likert scale going from "strongly agree" to "strongly disagree". Find out more information on the Likert scale [here](#).
5. `likert_seven` - A seven point Likert scale that also includes "somewhat agree" and "somewhat disagree". Find out more information on the Likert scale [here](#).

\*For `selectbox` and `checkbox` response types, you will need to set the options that participants will have. This can be done using the `"...response_options"` arguments.

To specify this, for each `selectbox` and `checkbox` response type in each section, create a list of equal length to the number of these response types. Each element within the list should contain a character vector of the options.

For example:

```
start_questions <- c("How old are you?", "What is your current employment?", "Which of the
following pets do you own?")
start_questions_ID <- c("Age", "Employment", "Pets")
start_questions_type <- c("selectbox", "text", "checkbox")
start_response_options <- list(c("0-17", "18-49", "51 +"), c("dog", "cat", "rabbit", "fish", "snake"))
```

**Screening questions**

Screening questions offer you the opportunity to remove participants from taking part in the survey if they do not meet certain criteria. These will all be `selectbox` response types. To specify how to screen participants, add `":SCREEN"` to the response options for which, if chosen, the participant should be removed.

For example, if participants do not consent or are under 18, they will be removed from the following survey:

```
screen_questions <- c("Do you consent to this study?", "How old are you?")
screen_questions_ID <- c("Consent", "Age")
screen_response_options <- list(c("No:SCREEN", "Yes"), c("0-17:SCREEN", "18-49", "51+"))
```

### Happy with your BIO-WELL survey design?

Once you have customised your survey, you need to save the R script as "app.R" within a designated folder for your BIOWELL survey Shiny App.

This R script should contain nothing other than "BIOWELL::build\_survey()" with the arguments to the function in-filled between the brackets. See Vignette 3 for more details.

You can then deploy your survey onto the Shiny Server using the `create_URL()` function.

### Language options

An exciting feature of the BIOWELL package is the ability to specify the language for the BIO-WELL scale. The wellbeing sliders have been professionally translated into 32 languages which includes consultation with native speakers. Select a language from the below list.

- arabic + bengali\_india + cantonese\_hong\_kong + cantonese\_taiwan + danish + dutch + edo + english + finnish + french + german + gujarati + indonesian + irish + italian + japanese + korean + malay + norwegian + polish + portuguese + portuguese\_brasil + punjabi\_india + punjabi\_pakistan + russian + scottish\_gaelic + spanish + swedish + urdu\_india + urdu\_pakistan + welsh. #’ Please see Vignette 2 in the BIOWELL package for full guidance on this function.

### Extra variables recorded

In addition to the participants responses to survey questions, the survey records the following variables with each submitted response:

- `survey_duration` - the time in seconds between the participants starting the survey and submitting their responses.
- `start_date` - the date that participants began the survey in YYYY-MM-DD format.
- `start_time` - the time that participants began the survey in HH-MM-SS format.
- `end_date` - the date that participants submitted their responses to the survey in YYYY-MM-DD format.
- `end_time` - the time that participants submitted their responses to the survey in HH-MM-SS format.
- `timezone` - the time zone of participants.
- `timezone_location` - the broad location of the participant’s time zone.
- `server_submit_time` - the time in the Shiny Server’s time zone that participant responses were submitted.

### References

Irvine, K.N., Fisher, J.C., Bentley, P.R., Nawrath, M., Dallimer, M., Austen, G.E., Fish, R. and Davies, Z.G., 2023. BIO-WELL: The development and validation of a human wellbeing scale that measures responses to biodiversity. *Journal of Environmental Psychology*, 85, p.101921. doi:10.1016/j.jenvp.2022.101921

### Examples

```
build_survey(
  survey_title = "Insert survey title here",
  sidepanel_message = "Insert sidepanel message here.",
  start_message = "Insert start message here",
  screen_message = "Insert screen message here",
```



```

screen_questions = c("Insert participant screening question here"),
screen_questions_ID = c("Screening_Q1"),
screen_response_options = list(c(
  "You will be removed:SCREEN",
  "You will not be removed"
)),
start_questions = c(
  "Insert start question: text",
  "Insert start question: selectbox",
  "Insert start question: checkbox",
  "Insert start question: likert_five",
  "Insert start question: likert_seven"
),
start_questions_ID = c(
  "text_SQ1",
  "selectbox_SQ2",
  "checkbox_SQ3",
  "likert_five_SQ4",
  "likert_seven_SQ5"
),
start_questions_type = c("text",
  "selectbox",
  "checkbox",
  "likert_five",
  "likert_seven"),
start_response_options = list(
  c('Choose', 'one', 'of', 'these'),
  c('Choose', 'multiple', 'of', 'these')
),
biowell_setting = c(
  "Insert description of biowell environmental space setting 1.",
  "Insert description of biowell environmental space setting 2."
),
biowell_setting_ID = c("setting1", "setting2"),
biowell_questions = list(
  c("Insert biodiversity stem question here BW1"),
  c(
    "Insert biodiversity stem question here - BW2",
    "Insert biodiversity stem question here - BW3"
  )
),
biowell_questions_ID = list(c("BW.S1.Q1"),
  c("BW.S2.Q1",
    "BW.S2.Q2")),
end_questions = c(
  "Insert end question: text",
  "Insert end question: selectbox",
  "Insert end question: checkbox",
  "Insert end question: likert_five",
  "Insert end question: likert_seven"
),
end_questions_ID = c(
  "text_EQ1",
  "selectbox_EQ2",
  "checkbox_EQ3",
  "likert_five_EQ4",
  "likert_seven_EQ5"
)

```

```

),
end_questions_type = c("text",
                        "selectbox",
                        "checkbox",
                        "likert_five",
                        "likert_seven"),
end_response_options = list(
  c('Choose', 'one', 'of', 'these'),
  c('Choose', 'multiple', 'of', 'these')
),
end_message = "Insert end message here.",
Dropbox_App_folder = "insert_Dropbox_App_folder_name",
BW_app_path = tempdir(),
organisation = "BIOWELL package example",
organisation_website = "https://github.com/r-a-dobson/BIOWELL",
all_questions = TRUE,
all_sliders = FALSE,
user_report = TRUE,
offline_mode = TRUE
)

```

---

create\_URL

---

*Deploy BIO-WELL survey to Shiny Server*


---

## Description

Function to deploy BIO-WELL survey Shiny App to the Shiny Server and return a URL for survey distribution to participants.

## Usage

```

create_URL(
  BW_app_path,
  BW_app_name,
  Shiny_Server_user,
  Shiny_Server_token,
  Shiny_Server_secret
)

```

## Arguments

BW_app_path	a character string, the path to your BIO-WELL Shiny App folder.
BW_app_name	a character string, a name for your BIO-WELL Shiny App.
Shiny_Server_user	a character string, your Posit Shiny Server username.
Shiny_Server_token	a character string, your Posit Shiny Server Token.
Shiny_Server_secret	a character string, your Posit Shiny Server Secret.

## Details

To share the BIO-WELL survey that you have built using `build_survey()` with participants, we provide `create_URL()` to upload your BIOWELL survey Shiny App to the [Posit Shiny Server](#).

For this, you will first need to register for a free Posit Shiny Server account on their website. This will provide you with your Shiny Server username, token and secret for input into the `create_URL()` function, which acts as a wrapper for the `rsconnect` [R package](#).

To deploy the app successfully, ensure that you have:

1. Activated a long-lived Dropbox access token. This should be stored within your BIO-WELL survey Shiny App (automatically done using `activate_dropbox()` function).
2. Within your BIO-WELL survey Shiny App folder, an R script named "app.R" should be saved. This R script should contain your input into `build_survey()`. Please remember to include nothing in the script apart from this function and your filled arguments (e.g. `no "library(BIOWELL)"` or `"setwd()"`), and to specify the package that the `build_survey()` function is from by using the double-colon operator (i.e. `BIOWELL::build_survey()` with your arguments within the brackets).

Once the function has been run, the BIO-WELL survey Shiny App will be deployed to your Shiny Server account. This may take a couple of minutes, and will finish by loading the URL in your browser and returning the URL in the R Console.

If you are re-uploading the BIO-WELL survey for any reason, look out for a message to confirm this by running 'Y' in the R Console.

The URL can now be shared to participants for online access to your BIO-WELL survey. Responses will be remotely saved to your Dropbox account. You can check the status of your App on the [posit Shiny Server app dashboard](#).

Please see Vignette 3 in the BIOWELL package for full guidance on this function.

## Value

a character string, the URL to your deployed BIO-WELL survey Shiny App.

## Examples

```
BW_app_path <- paste0(tempdir(), "/my_app_name_1")

dir.create(BW_app_path) # Store your "app.R" script here

BIOWELL::create_URL(BW_app_path = paste0(tempdir(), "/my_app_name_1"),
                    BW_app_name = "my_app_name_1",
                    Shiny_Server_user = 'your_username_here',
                    Shiny_Server_token = 'your_token_here',
                    Shiny_Server_secret = 'your_secret_here')
```

---

download\_data

Combine BIO-WELL survey responses into a data frame

---

### Description

Function downloads survey responses from a Dropbox App folder and combines them into a single data frame.

### Usage

```
download_data(Dropbox_App_folder, BW_app_path)
```

### Arguments

Dropbox\_App\_folder

path to the folder in your Dropbox App contain survey responses.

BW\_app\_path

a character string, the path to your BIO-WELL Shiny App folder.

### Details

Each set of participant responses to your BIO-WELL survey is stored as a single "csv" file within your Dropbox App folder.

download\_data() downloads all participant responses and combines them into a single data frame. Each row represents responses from a participant.

### Value

Data frame containing combined responses to BIO-WELL survey

### BIO-WELL score columns

For each BIO-WELL question, the scores for each of the five scales are given (Physical, Emotional, Cognitive, Social and Spiritual) in RAW and INVERTED format.

- The "\_RAW" value is the actual value between 0 and 100 that users specify with the sliders, whereby 0 is a positive wellbeing response to biodiversity and 100 is a negative response.
- The "\_INVERTED" value is calculated as 100 minus the RAW value. This is to improve interpretability of the BIO-WELL scores: 0 is a negative wellbeing response and 100 is a positive wellbeing response.

The final columns are overall inverted and raw BIOWELL scores. This is the average across all five scales across all BIO-WELL questions.

Please see Irvine et al., (2023) for more details on the BIO-WELL score.

## Extra variables recorded

In addition to the participants responses to survey questions, the downloaded data will contain columns for the following variables:

- survey\_duration - the time in seconds between the participants starting the survey and submitting their responses.
- start\_date - the date that participants began the survey in YYYY-MM-DD format.

- `start_time` - the time that participants began the survey in HH-MM-SS format.
- `end_date` - the date that participants submitted their responses to the survey in YYYY-MM-DD format.
- `end_time` - the time that participants submitted their responses to the survey in HH-MM-SS format.
- `timezone` - the time zone of participants.
- `timezone_location` - the broad location of the participant's time zone.
- `server_submit_time` - the time in the Shiny Server's time zone that participant responses were submitted.

## References

Irvine, K.N., Fisher, J.C., Bentley, P.R., Nawrath, M., Dallimer, M., Austen, G.E., Fish, R. and Davies, Z.G., 2023. BIO-WELL: The development and validation of a human wellbeing scale that measures responses to biodiversity. *Journal of Environmental Psychology*, 85, p.101921. doi:10.1016/j.jenvp.2022.101921

## Examples

```
data <- download_data(Dropbox_App_folder = "survey_responses",
                     BW_app_path = paste0(tempdir(), "/my_app_name_1"))

# See below a sample of downloaded survey participant data

data(sample_BW_data)

head(sample_BW_data)
```

---

evaluate\_survey

*Evaluate BIO-WELL survey*

---

## Description

Function to calculate key survey evaluation statistics on BIO-WELL survey responses.

## Usage

```
evaluate_survey(data)
```

## Arguments

<code>data</code>	a data frame containing the combined response data frames from a BIOWELL package survey. See <code>download_data()</code> to obtain this.
-------------------	---

## Details

Once you have combined all responses to your BIO-WELL survey into a single data frame using the `download_data()` function, this data frame can be input into `evaluate_survey()`.

`evaluate_survey()` returns six outputs in a list object:

**Value**

Returns a list containing a data frame of processed BIO-WELL scores, Cronbach's alpha statistic and item-total.

**Stem question statistics:**

The first three components are derived from the BIO-WELL score for each stem question, calculated by averaging slider responses across the five well-being domains.

1. A processed data frame containing the average BIO-WELL scores for each participant for each stem question within your custom BIOWELL package survey.
2. Cronbach's Alpha: the computed Cronbach's Alpha statistic measures the reliability, or internal consistency, of the five wellbeing sliders. This can be calculated for each biodiversity statement and will help understand the strength or consistency with which the sliders collectively measure a biopsychosocial-spiritual model of wellbeing. The resulting alpha statistic can be compared to those obtained in the original Irvine et al. (2023) article. This is calculated using `cronbach.alpha()` function from the `ltm` R package (Rizopoulos et al., 2007).
3. Item-total correlation and Cronbach's Alpha-without: the computed item-total statistic for each BIO-WELL question within your survey (Cronbach et al., 1951). This assesses how strongly scores on one wellbeing slider are related to scores on all the other wellbeing sliders. It also contributes to understanding the reliability of the wellbeing sliders as a measure of a biopsychosocial-spiritual model of wellbeing. Alpha without is the Cronbach Alpha reliability estimate of the scale without the variable. This is calculated using the `item.total()` function from the `multilevel` **R package**.

**Wellbeing domain x question:**

The latter three components are derived from the slider responses for each of the five wellbeing domains within each stem question (total stem questions x five).

1. A processed data frame containing the score for each wellbeing domain slider within each stem question given by each participant in your custom BIOWELL package survey dataset.
2. Cronbach's alpha (see 2 for description)
3. Item-total correlation and Cronbach's Alpha-without (see 3 for description)

**References**

- Cronbach, L. J. (1951) Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297–334.
- Rizopoulos, D., 2007. ltm: An R package for latent variable modeling and item response analysis. *Journal of statistical software*, 17, pp.1-25.

**Examples**

```
# Read in sample BIO-WELL survey data
data("sample_BW_data")

results<-evaluate_survey(sample_BW_data)

# Data frame containing average BIO-WELL scores for each participant x
# stem question

head(results[[1]])
```

```

# Statistics calculated using the average BIO-WELL score for each stem question:
# Cronbach's alpha
results[[2]]

# Item total and Cronbach's alpha without
results[[3]]

# Data frame containing BIO-WELL score for each participant x
# wellbeing domain question

head(results[[4]])

# Statistics calculated using the BIO-WELL score for each wellbeing domain:

## Cronbach's alpha
results[[5]]

# Item total and Cronbach's alpha without
results[[6]]

```

---

explore\_data

*Process and plot BIO-WELL scores*


---

## Description

Function to generate plots of BIO-WELL scores across questions and groups from BIO-WELL survey response data.

## Usage

```

explore_data(
  data,
  column_name,
  var_name,
  biowell_scale,
  plot = TRUE,
  score = "inverted"
)

```

## Arguments

data	a data frame containing the combined response data frames from a BIOWELL package survey. See <code>download_data()</code> to obtain this.
column_name	optional; a character string, the name of the column in data that contains categorical responses to split BIO-WELL scores by before plotting.
var_name	optional; the name for the variable to appear on the y axis of plot.
biowell_scale	optional; a character string, a single wellbeing domain to plot instead of full BIO-WELL scores. One of; physical, emotional, cognitive, social and spiritual. See details for more information.

plot	optional; a logical, indicating whether to show plots in the R window. Default is TRUE.
score	a character string, specifying whether to plot inverted or raw BIO-WELL scores. One of; inverted or raw Default; inverted. See details for more information.

## Details

This function can be used to plot average BIO-WELL scores from participant responses to your custom BIO-well survey (generated using `build_survey()`). Please see function `download_data()` for extracting your BIO-WELL survey response data from Dropbox.

All plots are created using the R package `ggplot2` (Wickham and Chang, 2016).

There are two approaches:

- Default: This will generate a box plot of BIO-WELL scores for each BIO-WELL question (`biowell_questions` in `build_survey()`) within each BIO-WELL environmental space setting (`biowell_setting` in `build_surveys()`). If more than one environmental space setting exists within your survey, these will be plotted in separately.
- Column: If a `column_name` is provided, for each unique category in this column, a box plot of average BIO-WELL scores for each participant will be generated. This can be used to compare average BIO-WELL scores across responses to other questions with your BIO-WELL survey (e.g. age categories or Likert scale responses)

## Value

a list object containing the plots and processed data frame.

## BIO-WELL scores

By default, the typical, inverted BIO-well score is plotted. This is calculated by taking the average score from across five wellbeing domains (physical, emotional, cognitive, social and spiritual). When inverted, the BIO-WELL score can be interpreted as 0-49, a negative wellbeing response to biodiversity, 50, a neutral wellbeing responses and 51-100 representing a positive wellbeing response to biodiversity. The raw BIO-WELL scores represents the opposite of this with 0-49, a positive wellbeing response to biodiversity, 50, a neutral wellbeing responses and 51-100 representing a negative wellbeing response.

Please see Irvine et al., (2023) for more details on the BIO-WELL score.

However, if you would like to only look at one of the wellbeing domains, then you can use the argument `biowell_scale` to specify which to plot.

Please see Vignette 4 in the BIOWELL package for full guidance on this function.

## References

- Irvine, K.N., Fisher, J.C., Bentley, P.R., Nawrath, M., Dallimer, M., Austen, G.E., Fish, R. and Davies, Z.G., 2023. BIO-WELL: The development and validation of a human wellbeing scale that measures responses to biodiversity. *Journal of Environmental Psychology*, 85, p.101921.doi:10.1016/j.jenvp.2022.101921
- Wickham, H. and Chang, W. , 2016. Package ‘ggplot2’. Create elegant data visualisations using the grammar of graphics. Version, 2(1), pp.1-189.



## Examples

```
data("sample_BW_data")

# Average BIO-WELL scores for each question across all participants
results <- explore_data(sample_BW_data)

# Average BIO-WELL score for each Gender response category
results <- explore_data(sample_BW_data,
                        column_name = "Gender")

# Average score in the emotional wellbeing domain of BIO-WELL across age groups.
results <- explore_data(sample_BW_data,
                        column_name = "Age",
                        biowell_scale = "emotional")

# Average BIO-WELL scores across sight impairment responses
results <- explore_data(sample_BW_data,
                        column_name = "impairment.sight")
```

---

sample_BW_data	<i>Sample BIO-WELL survey response data</i>
----------------	---

---

## Description

A dataset containing a sample of participant responses to a BIO-WELL survey aim to relate woodland biodiversity to human wellbeing. These data were collected for case study five from the study by Irvine et al., (2023).

## Usage

```
sample_BW_data
```

## Format

A data frame with 300 rows and 191 variables:

**survey\_duration** The length of time participants took answering survey questions.  
**start\_date** The date that participants started the survey (format: YYYY-MM-DD).  
**start\_time** The time when participants started the survey (format: HH:MM:SS)  
**end\_date** The date that participants completed the survey (format: YYYY-MM-DD).  
**end\_time** The time when participants finished the survey (format: HH:MM:SS)  
**timezone** The time zone in which start\_time and end\_time is recorded.  
**timezone\_location** The geographic location of the time zone.  
**server\_submit\_time** The time when participants finished the survey in the server's time zone.  
**Consent** Participants responses to the survey consent question.  
**Age** Participants responses to the survey consent question.  
**Gender** The age range of participants.  
**Country** The country in which participants reside.

**Urbanicity** Whether participants considered themselves to be living in a rural or urban area.

**forest\_Encountering.living.things\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Encountering.living.things\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Number.of.living.things\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.living.things\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Interactions.between.living.things\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Living.processes\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.sounds\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.sounds\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.sounds\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.sounds\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.sounds\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

- forest\_Variety.of.sounds\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.sounds\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.sounds\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.sounds\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.sounds\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Distinctive.sounds\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

- forest\_Variety.of.colours\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.colours\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

- forest\_Vivid.colours\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Vivid.colours\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.shapes\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')



**forest\_Maturity.of.living.things\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Maturity.of.living.things\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.textures\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.textures\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.textures\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.textures\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

- forest\_Variety.of.textures\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.textures\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.textures\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.textures\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.textures\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Variety.of.textures\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Sponginess.of.living.things\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Sponginess.of.living.things\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Sponginess.of.living.things\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Variety.of.smells\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Woody.smells\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Woody.smells\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Woody.smells\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

- forest\_Woody.smells\_Emootional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Woody.smells\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Woody.smells\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Woody.smells\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Woody.smells\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Woody.smells\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Woody.smells\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Emootional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Emootional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')
- forest\_Changes.in.this.season\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Changes.in.this.season\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Changes.in.this.season\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Physical\_RAW** The raw score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Physical\_INVERTED** The inverted score from the physical wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Emotional\_RAW** The raw score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Emotional\_INVERTED** The inverted score from the emotional wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Cognitive\_RAW** The raw score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Cognitive\_INVERTED** The inverted score from the cognitive wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Social\_RAW** The raw score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Social\_INVERTED** The inverted score from the social wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Spiritual\_RAW** The raw score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**forest\_Presence.of.animals\_Spiritual\_INVERTED** The inverted score from the spiritual wellbeing domain slider scale (component of the BIO-WELL scale) in response to the question 'encountering the living things (e.g. plants, fungi and animals) in this woodland makes me feel...')

**visits\_aschild** The extent to which participants agreed that they spent a lot of time in woodlands as a child.

**visits\_asteen** The extent to which participants agreed that they spent a lot of time in woodlands as a teen.

**visits\_asadult** The extent to which participants agreed that they spent a lot of time in woodlands as an adult.

**impairment.smell** Whether participants had a smell impairment or not.

**impairment.sound** Whether participants had a sound impairment or not.

**impairment.sight** Whether participants had a sight impairment or not.

**mean\_biowell\_INVERTED** The average BIO-WELL score across all bio-well questions for each participant (inverted; 100-row).

**mean\_biowell\_RAW** The average BIO-WELL score across all bio-well questions for each participant (raw)

## References

Irvine, K.N., Fisher, J.C., Bentley, P.R., Nawrath, M., Dallimer, M., Austen, G.E., Fish, R. and Davies, Z.G., 2023. BIO-WELL: The development and validation of a human wellbeing scale that measures responses to biodiversity. *Journal of Environmental Psychology*, 85, p.101921.

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