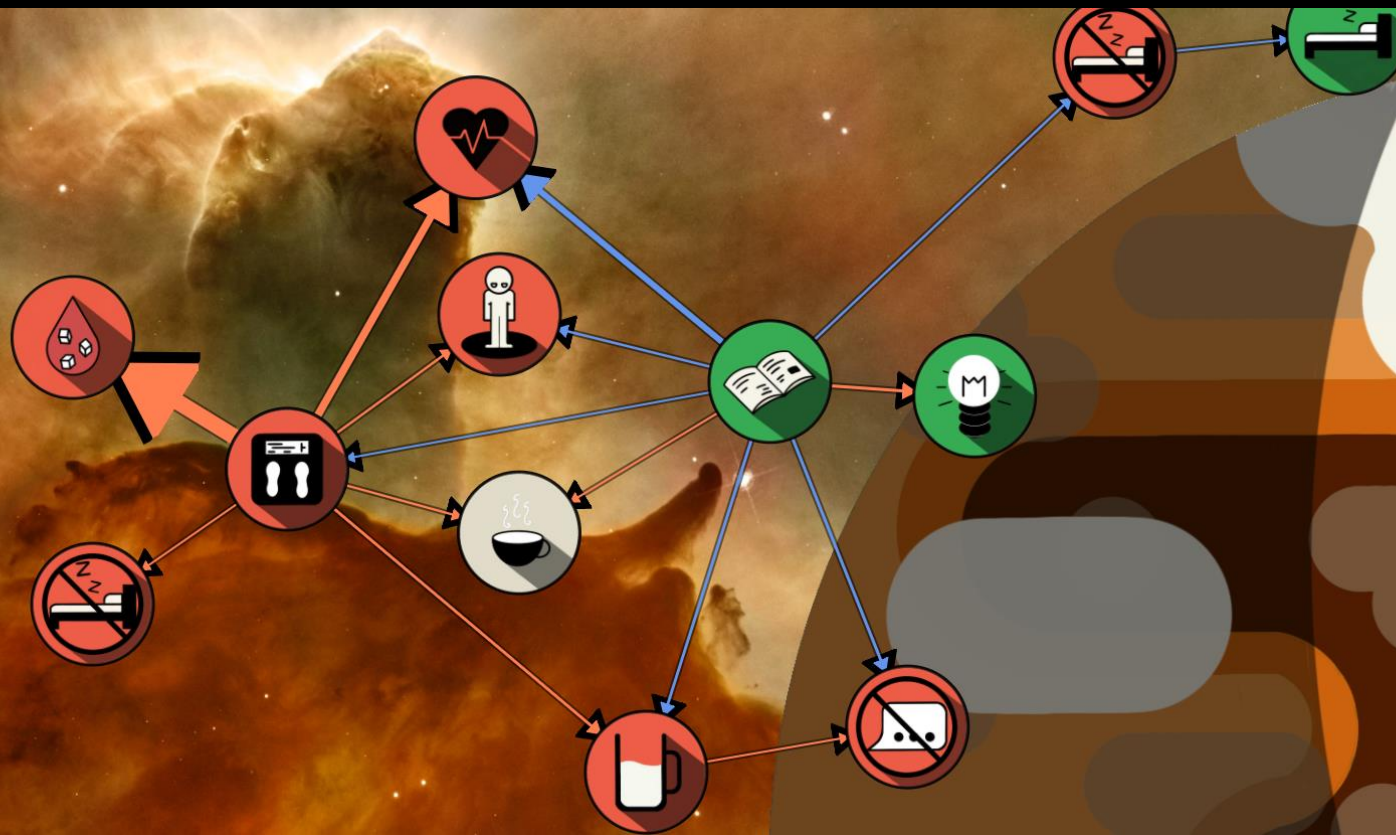


MiRANA: Visualising networks in genetic epidemiology



Chris Moreno-Stokoe,

PhD Psychology (Genetic epidemiology and interactive visualisation)

Live preview (v1.11)

<https://www.morenostok.io/mirana/>

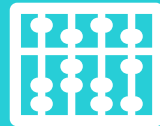
Example data set can be downloaded here:

<https://www.morenostok.io/mirana/exampleMRdata.csv>

Questions
epidemiologists
want to answer



Is one trait related to another
trait?



If so, how strongly?



What is the reliability of this
estimate? Is there a third factor
confounding this estimate?

Output data from analysis

A typical dataset: CSV formatted estimates between numerous traits

Traits in analysis

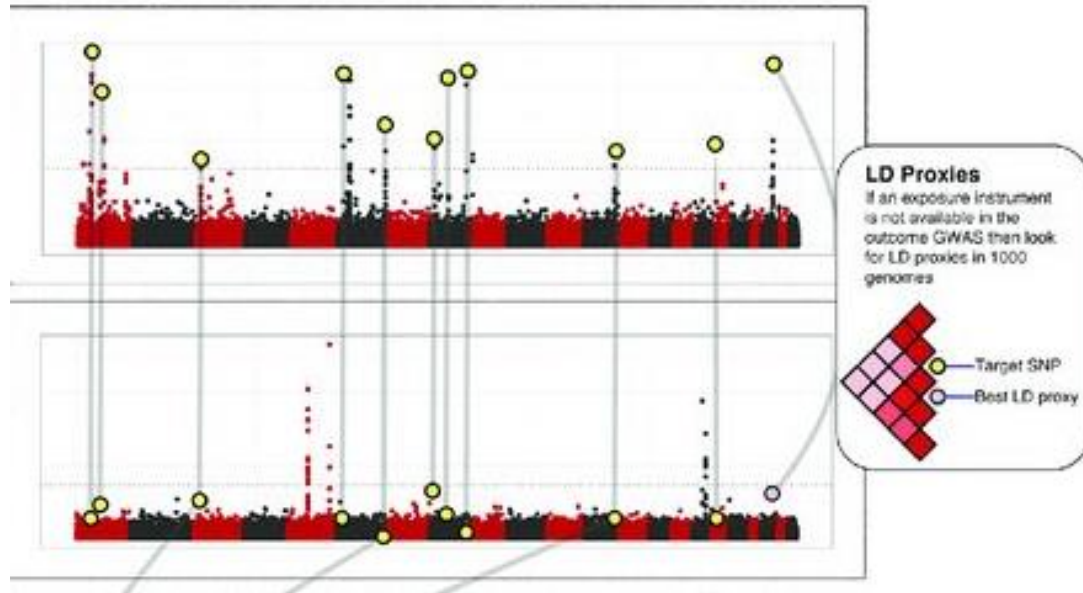
Betas give effect size

	A	B	C	D	E	F	G	H	I
1	id.exposure	id.outcome	outcome	exposure	method	nsnp	b	se	pval
2	1018	1018	Wellbeing id:1018	Wellbeing id:1018	Wald ratio	1	1	0.173611111	8.41E-09
3	1018	1189	OCD id:1189	Wellbeing id:1018	Wald ratio	1	-0.245318185	1.785519573	0.890720034
4	1018	1239	Education id:1239	Wellbeing id:1018	Wald ratio	1	-0.36755352	0.089957475	4.39E-05
5	1018	22	Schizophrenia id:22	Wellbeing id:1018	Wald ratio	1	-1.294949682	0.56791335	0.022596491
6	1018	961	Smoking id:961	Wellbeing id:1018	Wald ratio	1	-2.966779341	4.347944608	0.495023576
7	1018	UKB-b:10162	Shift work id:UKB-b:10162	Wellbeing id:1018	Wald ratio	1	0.411359176	0.377544252	0.275904606
8	1018	UKB-b:1585	Drugs id:UKB-b:1585	Wellbeing id:1018	Wald ratio	1	0.00827209	0.017229401	0.631145793
9	1018	UKB-b:17999	Phone use id:UKB-b:17999	Wellbeing id:1018	Wald ratio	1	0.511621779	0.155349744	0.000989996
10	1018	UKB-b:19953	BMI id:UKB-b:19953	Wellbeing id:1018	Wald ratio	1	0.618294079	0.104382474	3.15E-09
11	1018	UKB-b:4077	Socialisation id:UKB-b:4077	Wellbeing id:1018	Wald ratio	1	0.004465235	0.045149429	0.921218442
12	1018	UKB-b:4424	Sleep id:UKB-b:4424	Wellbeing id:1018	Wald ratio	1	-0.054307055	0.084271072	0.519294728
13	1018	UKB-b:4710	Exercise id:UKB-b:4710	Wellbeing id:1018	Wald ratio	1	0.041743857	0.261908007	0.87336661
14	1018	UKB-b:4779	Gaming id:UKB-b:4779	Wellbeing id:1018	Wald ratio	1	0.117492186	0.054672337	0.031632466
15	1018	UKB-b:5238	Intelligence id:UKB-b:5238	Wellbeing id:1018	Wald ratio	1	-1.728978119	0.399601552	1.51E-05
16	1018	UKB-b:5779	Alcohol id:UKB-b:5779	Wellbeing id:1018	Wald ratio	1	-0.114784829	0.159555483	0.471892124
17	1018	UKB-b:6519	Worry id:UKB-b:6519	Wellbeing id:1018	Wald ratio	1	-0.060346473	0.054043997	0.264157911
18	1018	UKB-b:8476	Loneliness id:UKB-b:8476	Wellbeing id:1018	Wald ratio	1	-0.199884146	0.042317177	2.32E-06
19	22	1018	Wellbeing id:1018	Schizophrenia id:22	MR Egger	60	-0.064606501	0.034002003	0.062397605
20	22	1018	Wellbeing id:1018	Schizophrenia id:22	Weighted median	60	-0.008166662	0.00898004	0.363126466
21	22	1018	Wellbeing id:1018	Schizophrenia id:22	Inverse variance weighted	60	-0.021319319	0.007515005	0.004555387
22	22	1018	Wellbeing id:1018	Schizophrenia id:22	Simple mode	60	0.003496139	0.023880089	0.884101625
23	22	1018	Wellbeing id:1018	Schizophrenia id:22	Weighted mode	60	0.003496139	0.022665165	0.877937771
24	22	1187	Depression id:1187	Schizophrenia id:22	MR Egger	4	4.723089343	2.43048565	0.191447315
25	22	1187	Depression id:1187	Schizophrenia id:22	Weighted median	4	0.364399941	0.059905023	1.18E-09
26	22	1187	Depression id:1187	Schizophrenia id:22	Inverse variance weighted	4	0.269308329	0.166877605	0.106569189
27	22	1187	Depression id:1187	Schizophrenia id:22	Simple mode	4	0.384834861	0.05887081	0.007276427
28	22	1187	Depression id:1187	Schizophrenia id:22	Weighted mode	4	0.377440155	0.058525736	0.007561319
29	22	1189	OCD id:1189	Schizophrenia id:22	MR Egger	72	0.139429572	0.292131714	0.634647289
30	22	1189	OCD id:1189	Schizophrenia id:22	Weighted median	72	0.247239365	0.091913193	0.007146861

Different methods tell you about different biases

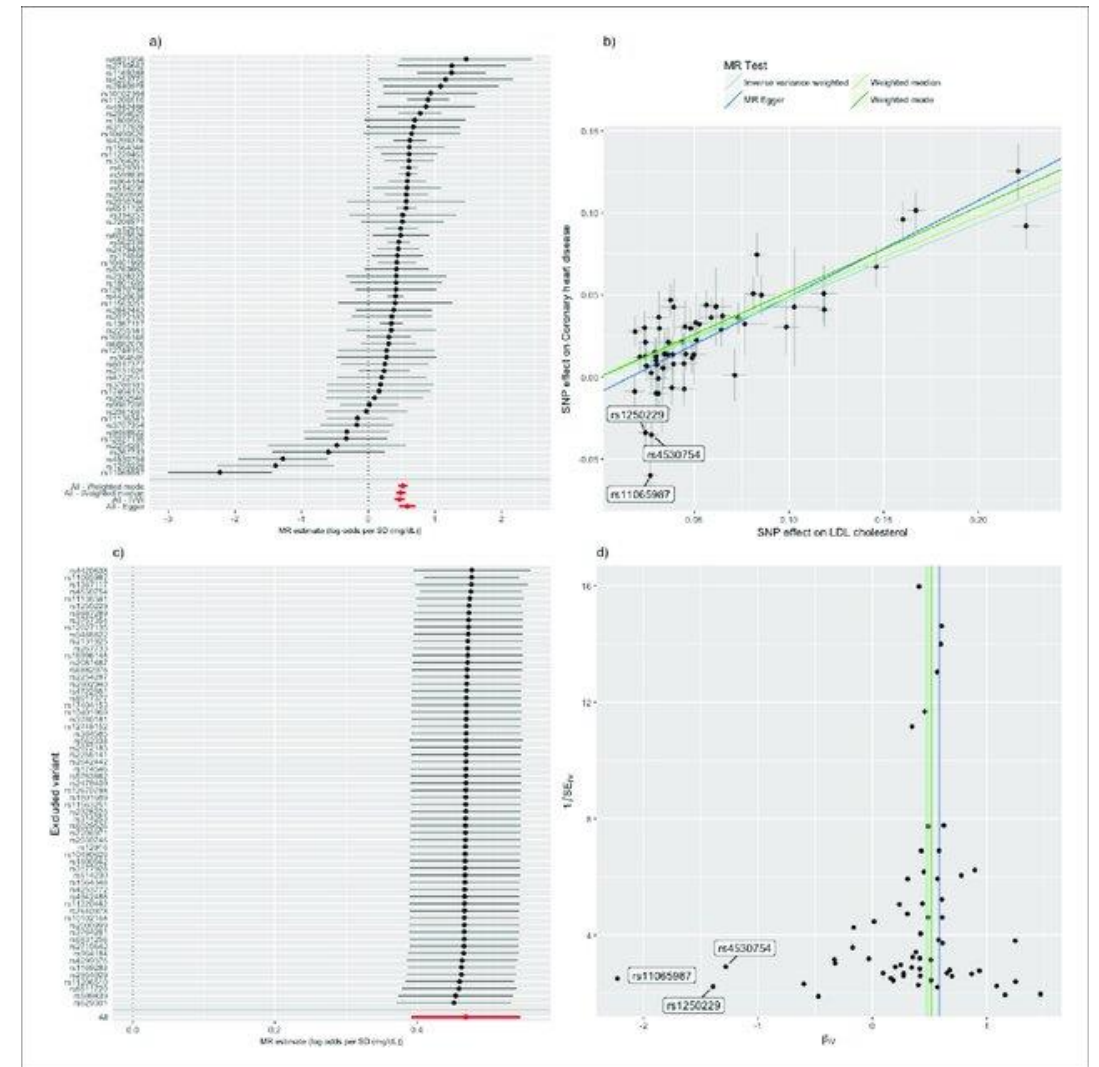
P Value gives some indication of reliability

Existing visualisations of analysis



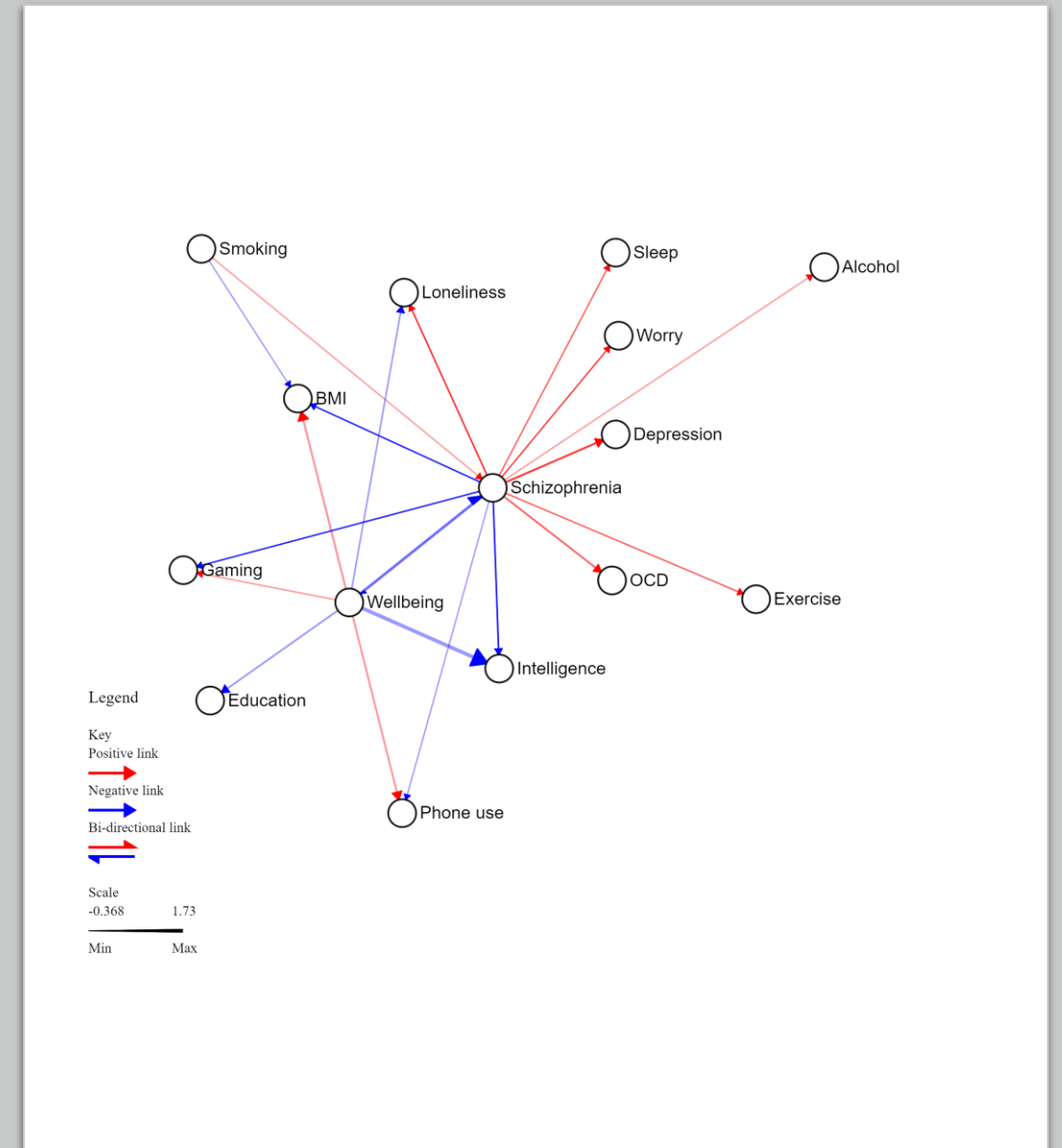
Hemani, G., Zheng, J., Elsworth, B., Wade, K. H., Haberland, V., Baird, D., ... & Tan, V. Y. (2018). The MR-Base platform supports systematic causal inference across the human phenome. *Elife*, 7, e34408.

- ...but none for network visualisation



This data visualised

- Representing data with nodes and arrows
- Immediately see:
 - Most influential traits
 - Strengths of effects
 - Identify potential mediators



Summary



Epidemiologists often analyse the effects of many traits at the same time



Understanding the interactions between traits is easier with network visualisation

The MiRANA platform

& its development

How was MiRANA developed?

MiRANA beta

Network visualisation tool

MRC Integrative Epidemiology Unit

Custom graph

1) Upload your data
Choose file Example data format.csv

2) Set pval cut-off
0.005

3) Generate graph
Tip: Drag circles to rearrange the graph
Generate graph

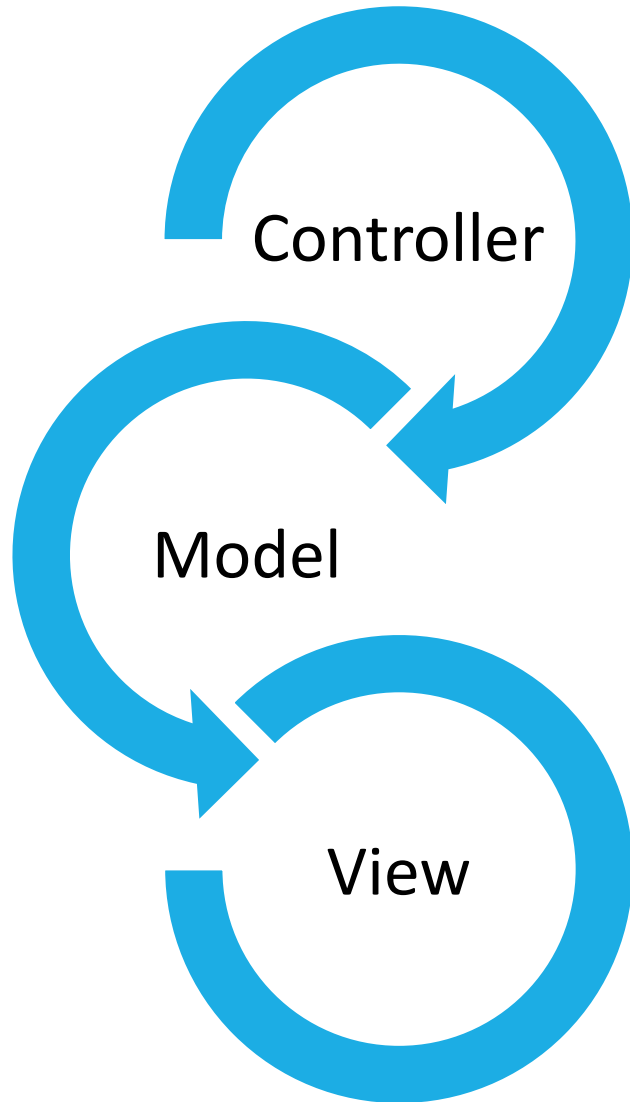
Cite this ▾

Note: Circles represent traits and red lines represent a positive causal relationship between two traits, whereas blue lines represent negative relationships. Arrowheads indicate the direction of causality. Bidirectional relationships are represented with arrows pointing in both directions.

Version 1.0

- Stand-alone website
- No database
- Hosted online in sync with github
- Entirely JavaScript
 - JQuery animations
 - D3 view
 - NetworkXJS model
 - Various saving utilities

MVC model



Controller

Collects user input to set settings

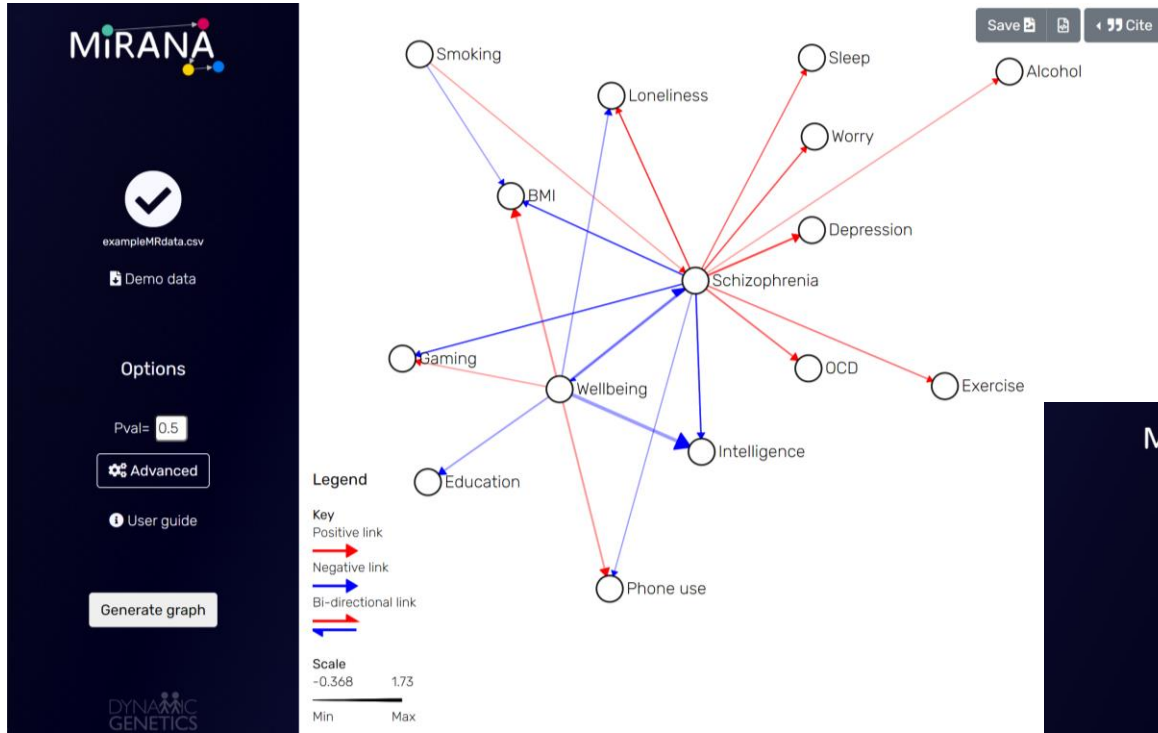
Model

Processes data

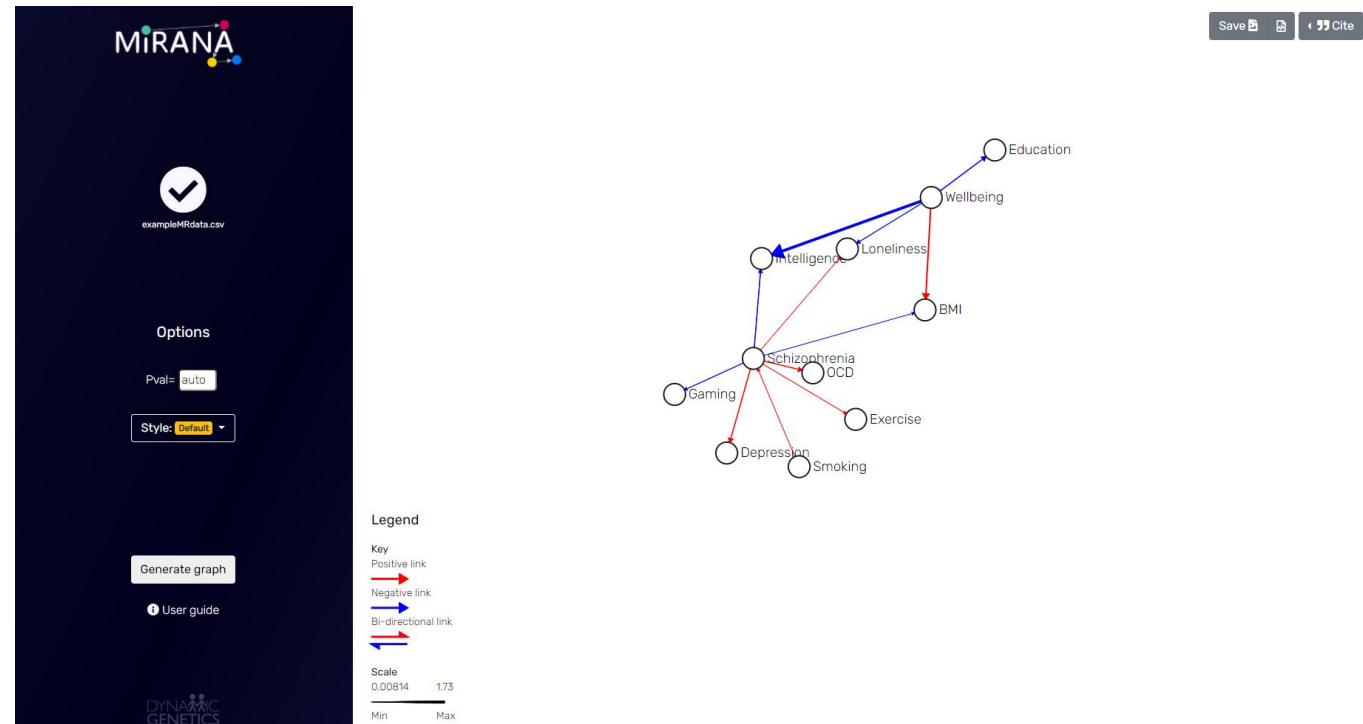
View

Outputs visualisation

Updated with customisation options and presets



V1.1 – customisation update



V1.11 – presets update

MiRANA Features:

Examples of visualisation outputs

Interrelation between bilingualism and cognition with influence of confounders with no clear evidence of a bilingual advantage

Legend

Key

Positive link — Negative link —

Node colors:

Cognitive measures

Executive Function (EF)



Performance across all cognitive tests (global)



Bilingualism measures



Confounding factors

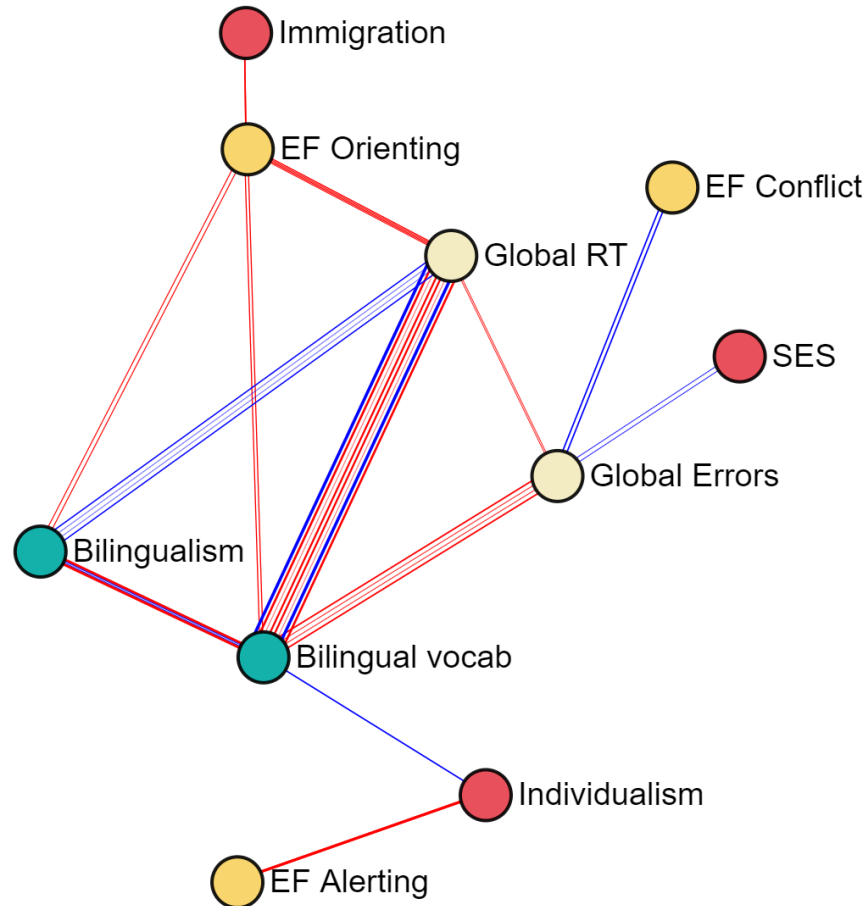


Scale

(line widths scaled to correlation coefficients, r)

0.205 0.417

Min Max

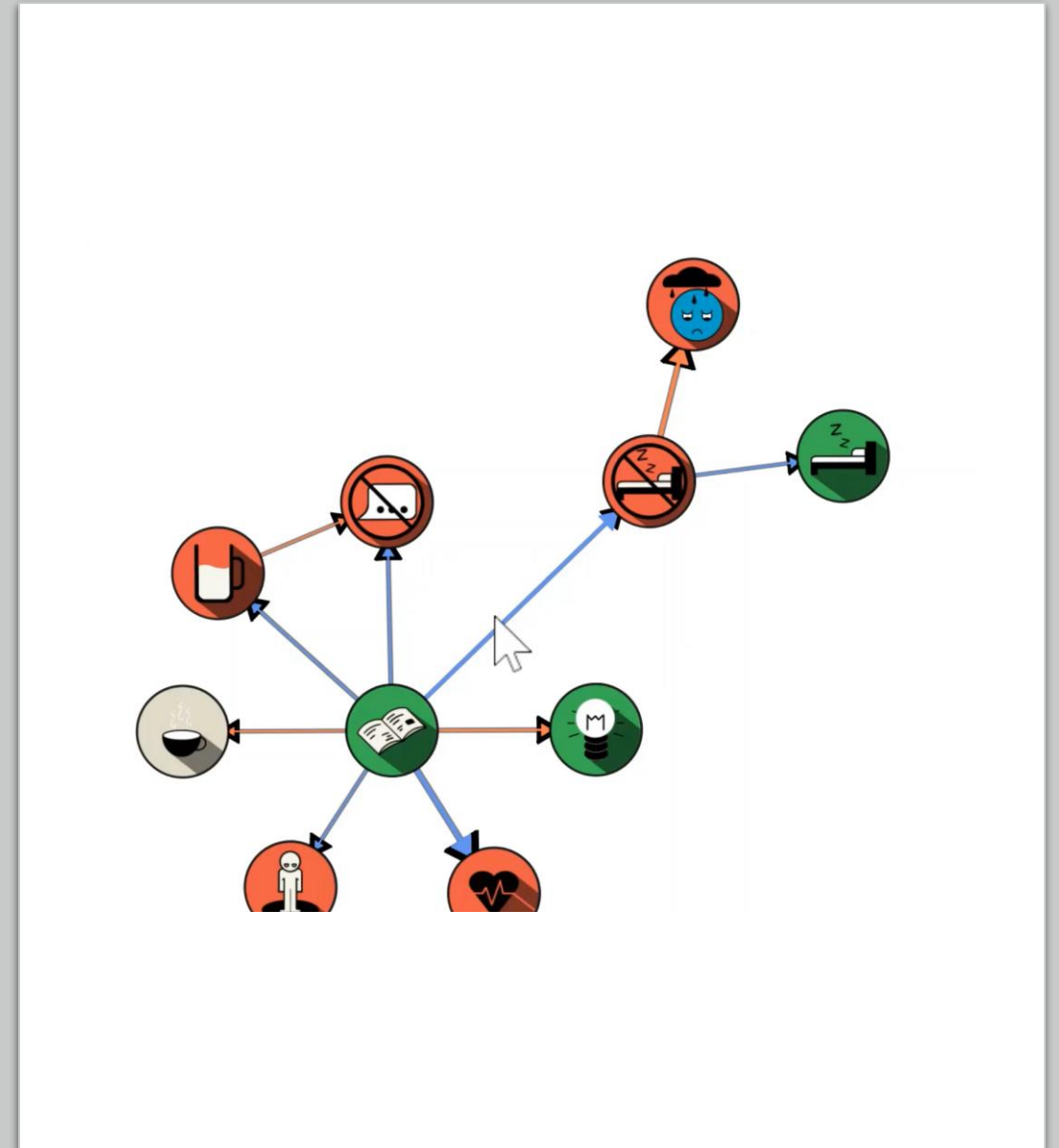


Mapping observational estimates

- Lines indicate correlations
- Group similar measures together
 - More lines = more measures show a correlation

Interactive visualisation features

- Reposition nodes at will
- Animations for data exploration



Video of animation in MiRANA

GUI interface for easy customisation

- Easy to use interface for data upload

The screenshot displays a network visualization interface with a light blue background. A network diagram is visible in the background, featuring nodes such as 'Intelligence', 'Loneliness', 'BMI', 'Gaming', 'Schizophrenia', 'MDD', 'Exercise', 'Depression', and 'Smoking'. The interface is divided into three main sections: 'Advanced settings', 'Edges', and 'Nodes'. The 'Advanced settings' section includes a 'Legend' with radio buttons for 'Causal data' (selected) and 'Observational data*', and a checkbox for 'Alternative view for bi-directional links'. The 'Edges' section has input fields for 'Color: -ve' (blue) and 'Color: +ve' (red), a checked checkbox for 'Scale line width by beta', and an 'Edge opacity' field set to 100%. The 'Labels' section includes a 'Font' field set to 'Rubik, sans-serif', radio buttons for 'Display names' (selected), 'Display IDs', and 'Display Icons*', radio buttons for 'Labels to right' (selected) and 'Labels in middle', and a checked checkbox for 'Better names: Rename traits'. The 'Nodes' section has input fields for 'Fill color' (white) and 'Outline color' (black), a 'Node opacity' field set to 100%, and a checkbox for 'Color from CSV*'. At the bottom, there is a 'Scale' section with a range from -0.368 to 1.73, and a footer with the text 'Items marked with * are experimental and not fully supported yet'.

Advanced settings

Edges

Color: -ve

Color: +ve

Scale line width by beta

Edge opacity

Show estimates from:

Causal data

Observational data*

Alternative view for bi-directional links

Labels

Font

Display names

Display IDs

Display Icons*

Labels to right

Labels in middle

Better names: Rename traits

Nodes

Fill color

Outline color

Node opacity

Color from CSV*

Scale

-0.368 1.73

Min Max

Legend

Positive link

Negative link

Footer

iA Fonts Colors

Items marked with * are experimental and not fully supported yet

Easy to use interfaces reduce barriers to use

Make a graph in three clicks

1 Upload data

Options

Pval= autc

Advanced

User guide

3 Generate graph

2

Interface for easy customisation

Advanced settings

Edges

Color: -ve blue

Color: +ve red

Scale line width by beta

Edge opacity 100%

Show estimates from:

all methods

Causal data

Observational data*

Alternative view for bi-directional links

Labels

Font Rubik, sans-serif

Display names

Display IDs

Display Icons*

Labels to right

Labels in middle

Better names: Rename traits

Nodes

Fill color white

Outline color black

Node opacity 100%

Color from CSV*

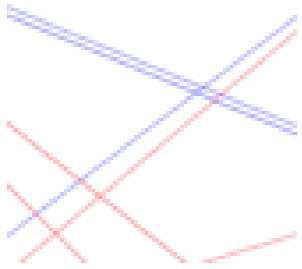
Scale -0.368 1.73

Min Max

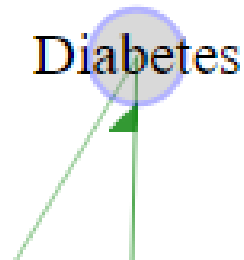
Items marked with * are experimental and not fully supported yet

Customisation options

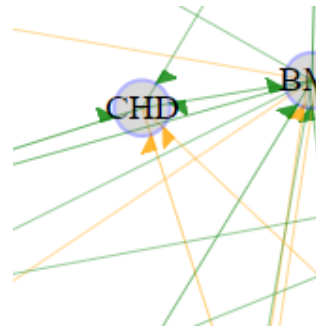
Transparency



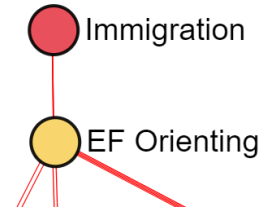
Node styles



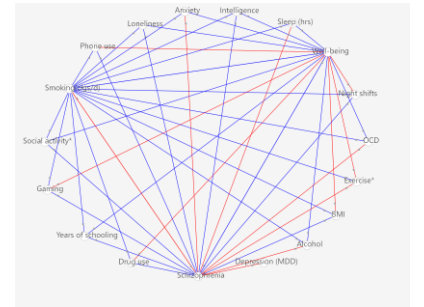
Line styles



Per node colors



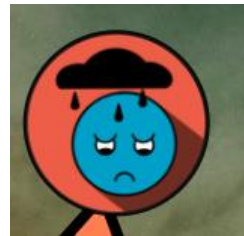
P-value threshold



Font

Depression
Depression
Depression

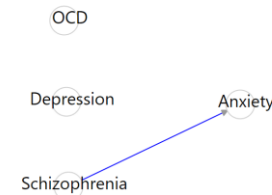
Per node icons



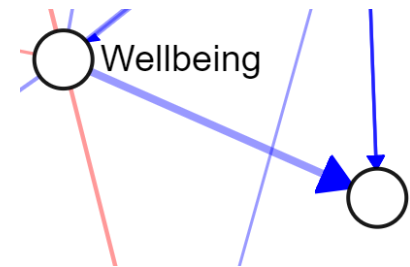
MR estimate filter

Show estimates from:

Reposition nodes




Scale edges to effect strength

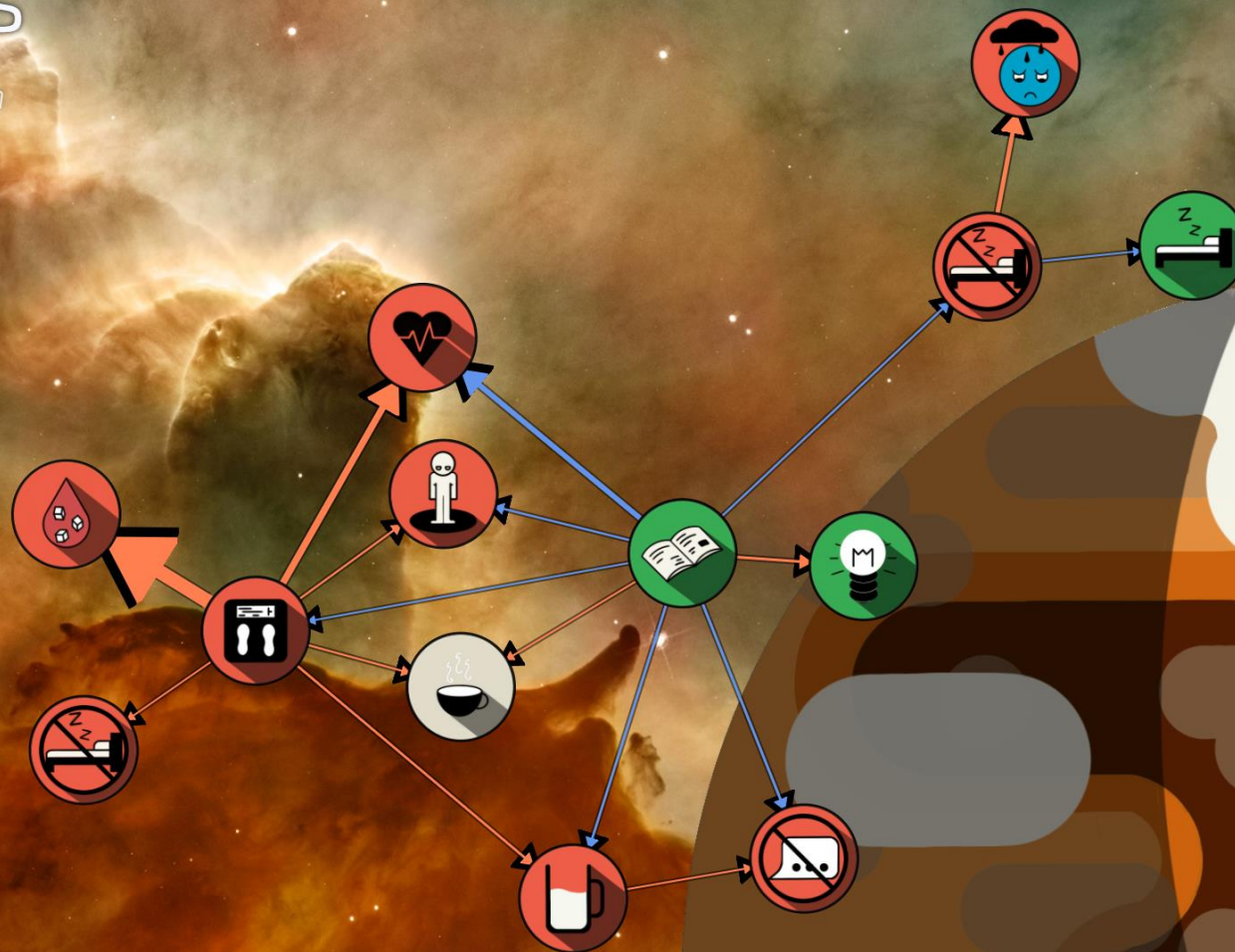


External integration

Amdusias

Aeries system

 ^ Raise Sleep duration



- Icons
- Interaction

Thank you

Twitter: @cmsTweets1