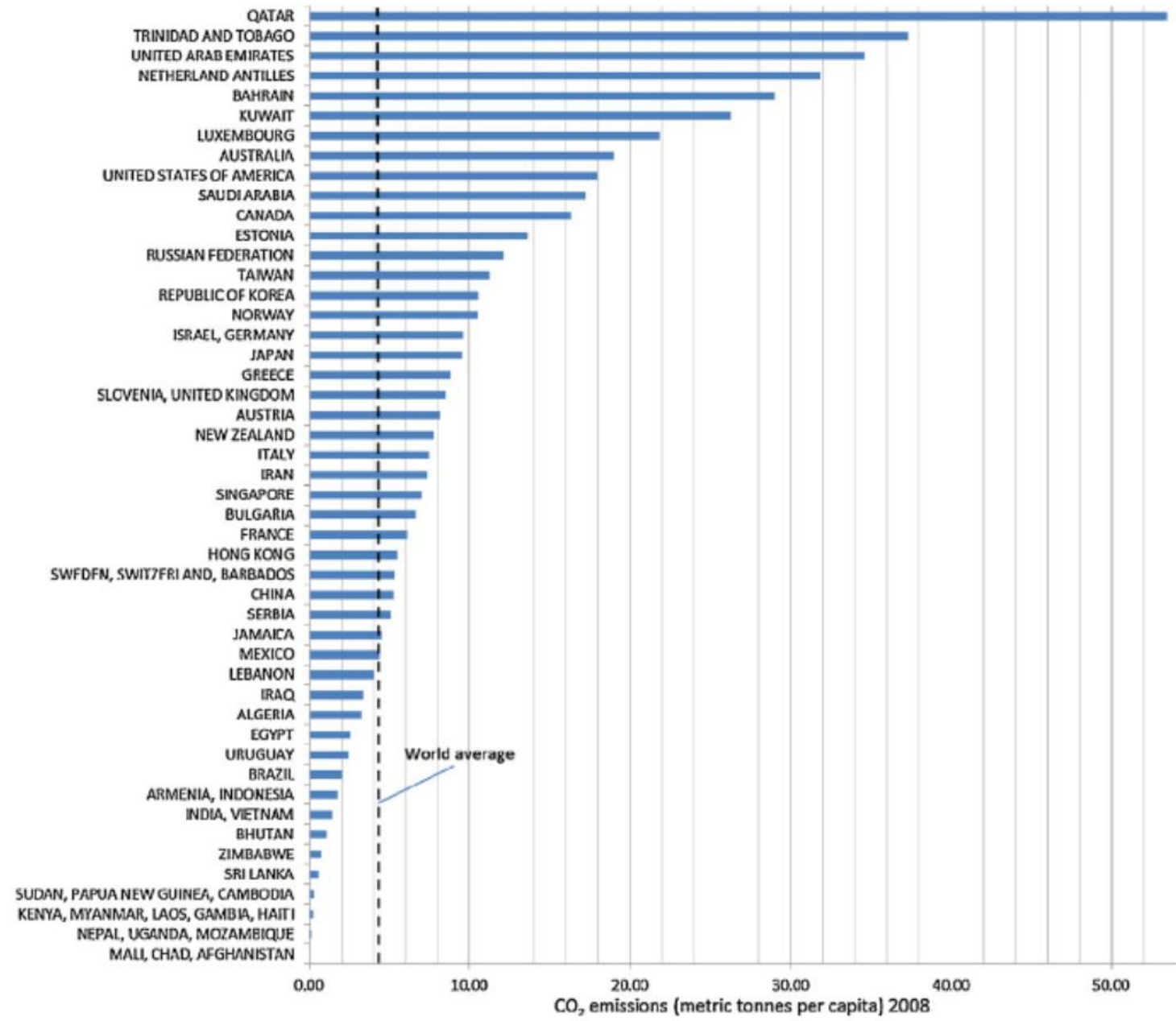


CHANGING BEHAVIOR WITH CHATBOTS: FROM IMPROVING MENTAL HEALTH TO TACKLING CLIMATE CHANGE.

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7th of May 2023





SOLUTIONS

- SYSTEMIC CHANGES
- INDUSTRIAL CHANGES
- INDIVIDUAL CHANGES





INDIVIDUAL CHANGES

But even if all of us individually did our best, we would only reduce emissions by 25%. **SOPHISM!** When we need so much more... So why bother?

Sophism of the perfect solution

Just because a solution is not perfect does not mean that it is not worth undertaking.

No one said that it's the only thing we need to do!



INDIVIDUAL CHANGES

Intuitive

Fast

Unconscious

Effortless

=> Nudges

Deliberate

Slow

Conscious

Effort

=> Deliberate thinking

INDIVIDUAL CHANGES

Behavior change can be done without conscious thought.

Nudges



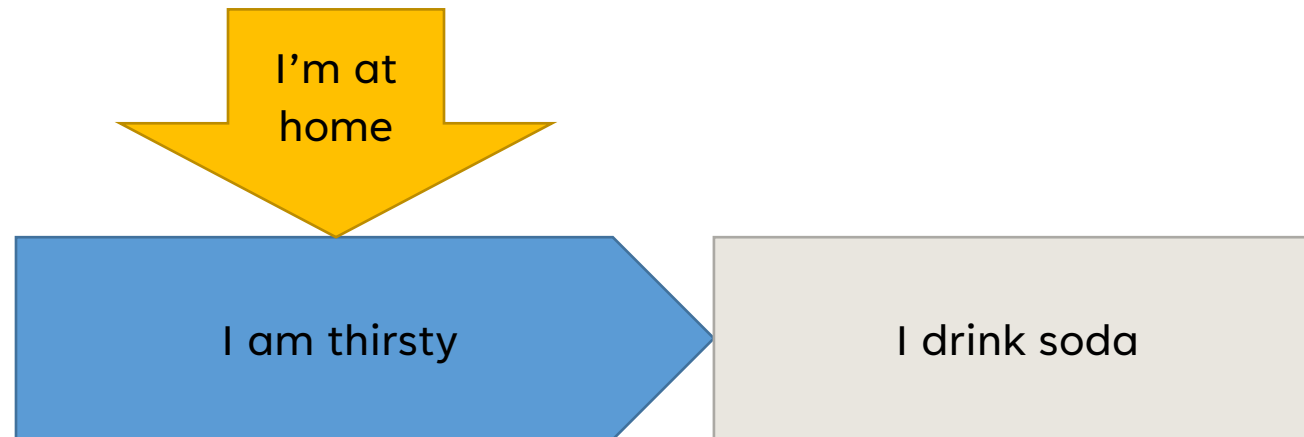
INDIVIDUAL CHANGES

But changing behavior is complicated...
...because we must change our habits.



INDIVIDUAL CHANGES

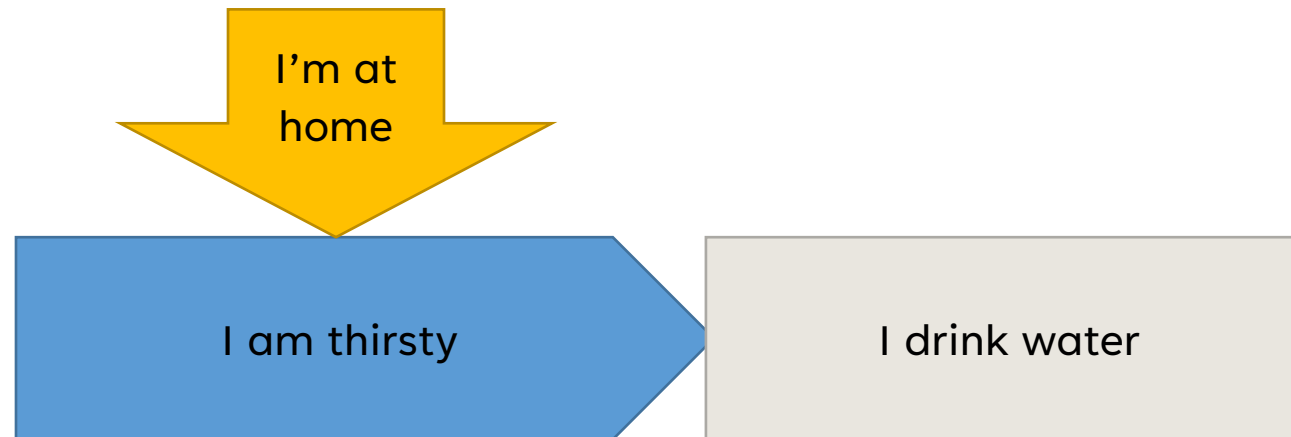
The strength of habits



Once this type of If-then rule is established in your unconscious processes, competing with it requires intentional, conscious thought.

INDIVIDUAL CHANGES

Implementation intentions



The goal then becomes creating alternative If-then rules by identifying where, when and how you want to do certain actions.

They require a lot of repetition to be automated, and sometimes they will still be less powerful than the long-established rule it tried to replace.

INDIVIDUAL CHANGES

Implementation intentions

Still, some successes have been shown in the literature :

- Diet changes, avoiding snacks (Adriaanse, 2009)
- Decreasing speed (Brewster, 2015)
- Decreasing smoking (Armitage, 2016)

Limitations :

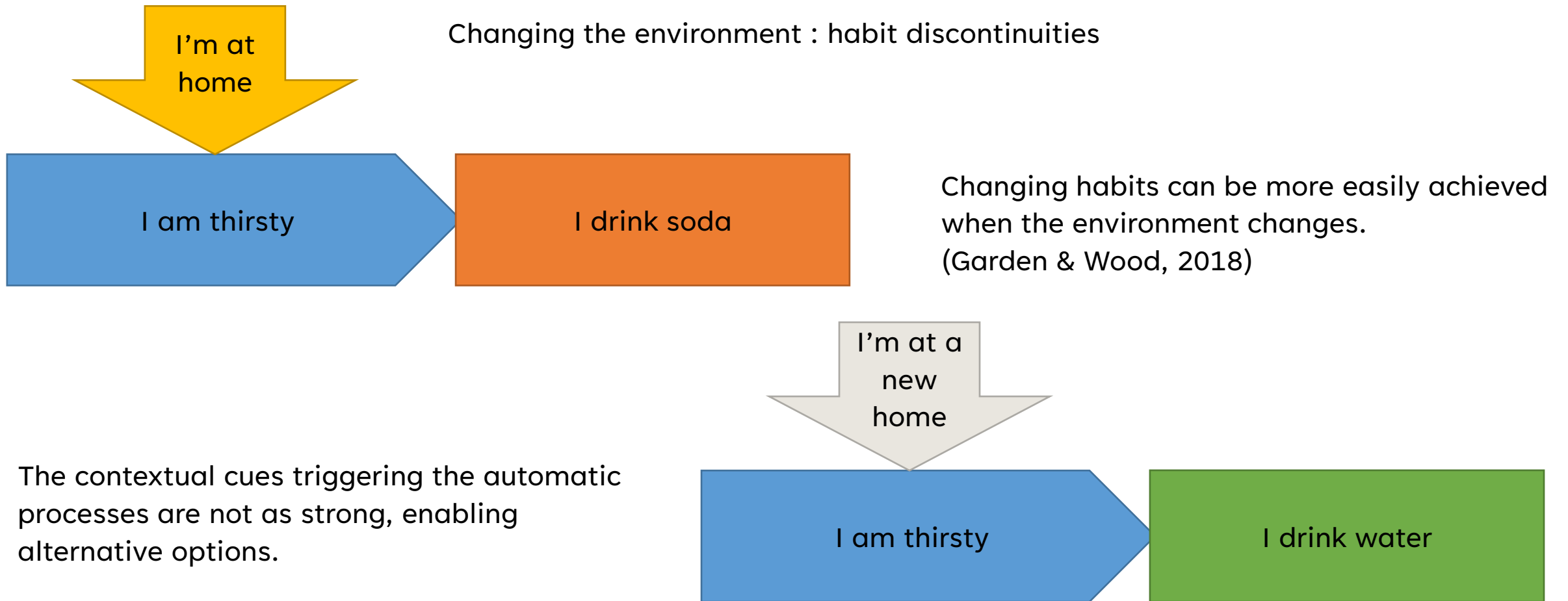
The stronger the habit, the more limited impact implementation intentions have.

Marieke A. Adriaanse, Denise T. D. de Ridder, and John B. F. de Wit. 2009. Finding the critical cue: Implementation intentions to change one's diet work best when tailored to personally relevant reasons for unhealthy eating. *Personality and social psychology bulletin* 35, 1 (2009), 60–71.

Sarah E. Brewster, Mark A. Elliott, and Steve W. Kelly. 2015. Evidence that implementation intentions reduce drivers' speeding behavior: testing a new intervention to change driver behavior. *Accident Analysis & Prevention* 74 (2015), 229–242.

Christopher J. Armitage. 2016. Evidence that implementation intentions can overcome the effects of smoking habits. *Health Psychology* 35, 9 (2016), 935

INDIVIDUAL CHANGES



Lucas Carden and Wendy Wood. 2018. Habit formation and change. Current opinion in behavioral sciences 20 (2018), 117–122

INDIVIDUAL CHANGES

Changing behavior

The main difficulty is ensuring that the change of habit is sustained.

To do so, external help might be required while the rule is not completely automated.

This is the main advantage of coaching techniques.

Essentially, the external agent replaces your automated processes that are not yet formed, reminding you to do certain tasks for you.

INDIVIDUAL CHANGES

Changing behavior

But... having someone else monitor what you are doing all the time and offer alternatives is not doable in practice for great numbers of people all at once.

In come the chatbots...

CHATBOTS

What is a chatbot ?



Chatbots are **virtual artificial** conversational agents.

They can be implemented on many devices, including computers and smartphones.

They (usually) interact through text messages.

CHATBOTS

What is a chatbot ?

There are two main types of chatbots :

Script-based

Generative

CHATBOTS

What is a chatbot ?

Script based chatbots are fairly straight-forward :

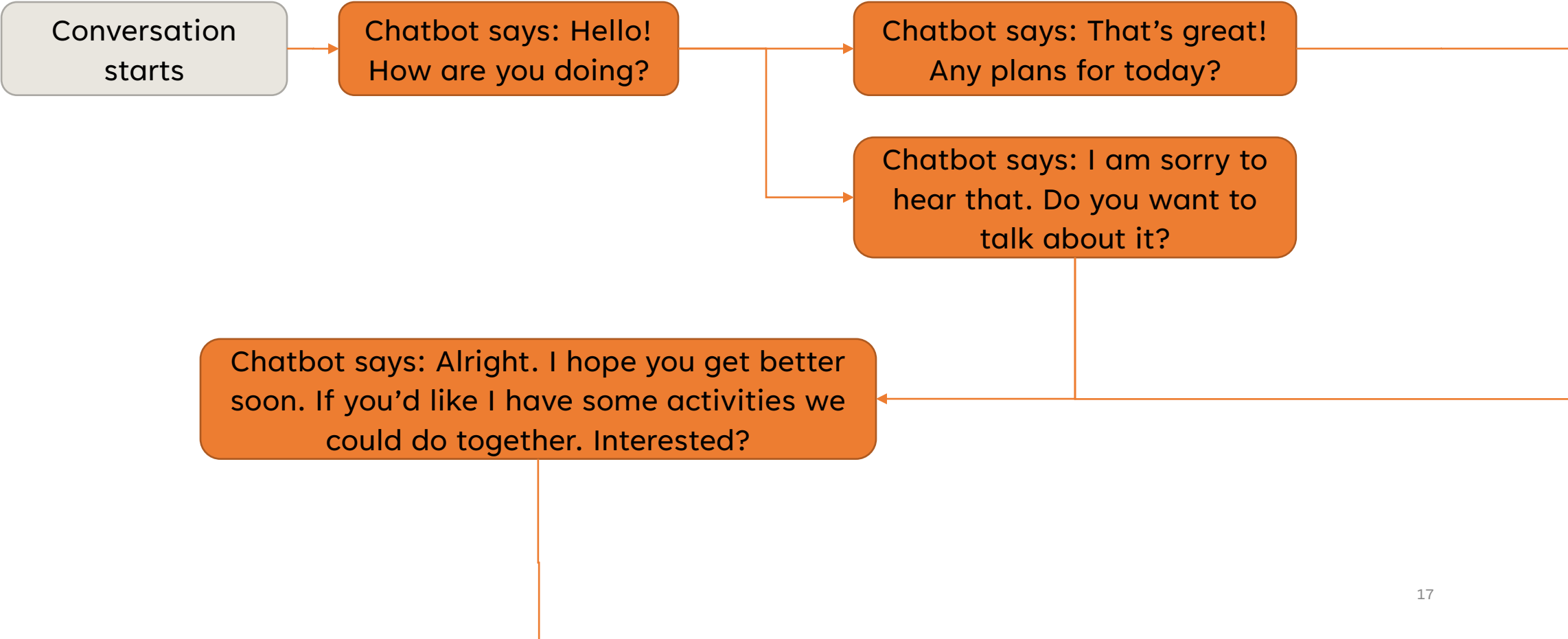
They follow pre-established scenarios, or scripts.

When the user interacts with the chatbot, the first step is to recognize which part of the script this interaction corresponds to.

The second step is to trigger the response interactions of the chatbot.

CHATBOTS

Example of a script base chatbot



CHATBOTS

Script-based chatbots

Script based chatbots are great when the artificial agent is required to take the lead in a conversation with specific goals.

The conversation can be finely tuned to maximize the probability that this goal will be reached.

There are two main difficulties :

- Recognizing user intent
- Providing sufficient paths

CHATBOTS

Generative chatbots

Generative chatbots do not have a predefined script.

They generate a new response for each of the user's utterances.

Extremely flexible.

They have some limitations though :

- They require a MASSIVE amount of data to be trained on.
- It is hard to control what they say.
- It is hard to know where the information they provide comes from.
- They can lack of relevance.

CHATBOTS

Chatbot coaching

Advantages:

- They are available 24/7.
- They are cheap (often free) and do not require a specific, intrusive setup at home.
- They can follow you everywhere (phone).

Disadvantages:

- They only know what you tell them and have no way to ensure what you tell them is true.
- They can become somewhat repetitive.
- Questions on data privacy.

CHATBOTS

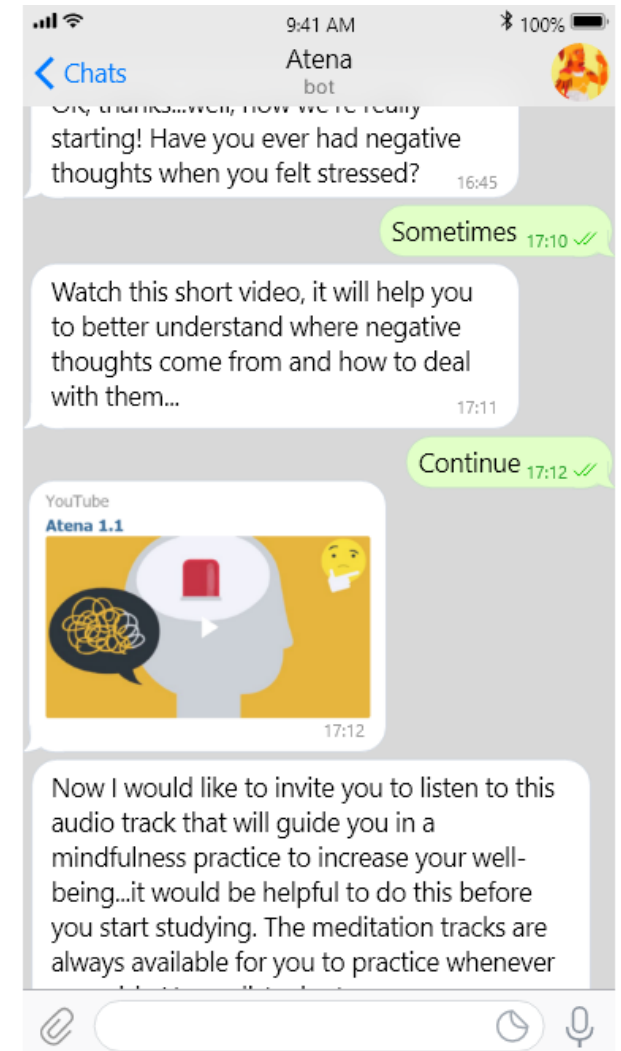
Chatbot coaching

Case of the ATENA chatbot

Developed to help students cope with anxiety during the COVID-19 pandemic.

Used in interventions to mitigate stress and anxiety and to increase mindfulness.

Students were made aware that the chatbot was not a replacement for professional mental health treatment.



CHATBOTS

| | Questionnaire (N=41) | Questionnaire score, mean (SD) | | Mean difference (SD) | t test (df=39) | P value ^a |
|--|--------------------------|--------------------------------|------------------|----------------------|----------------|----------------------|
| | | Preintervention | Postintervention | | | |
| ^b GAD-7: 7-item Generalized Anxiety Disorder scale. | GAD-7 ^b | 10.49 (4.62) | 9.29 (0.72) | 1.19 (4.14) | 1.85 | .07 |
| | PSS-10 ^c | 22.49 (6.52) | 20.83 (0.97) | 1.66 (5.30) | 2.00 | .05 |
| ^c PSS-10: 10-item Perceived Stress Scale. | FFMQ^d | | | | | |
| | Observing facet | 23.15 (5.84) | 23.37 (6.50) | -0.22 (5.43) | -0.259 | .80 |
| | Describing facet | 23.05 (7.29) | 24.98 (6.03) | -1.92 (5.29) | -2.33 | .03 |
| ^d FFMQ: Five-Facet Mindfulness Questionnaire. | Act with awareness facet | 26.15 (6.56) | 26.12 (6.99) | 0.02 (6.27) | 0.03 | .98 |
| | Nonjudging facet | 25.85 (7.78) | 28.02 (7.46) | -2.17 (6.09) | -2.28 | .03 |
| | Nonreacting facet | 18.41 (4.01) | 18.66 (4.85) | -0.24 (4.55) | -0.34 | .73 |
| | Total | 119.49 (16.56) | 147.27 (19.67) | -27.78 (16.74) | -10.62 | <.001 |

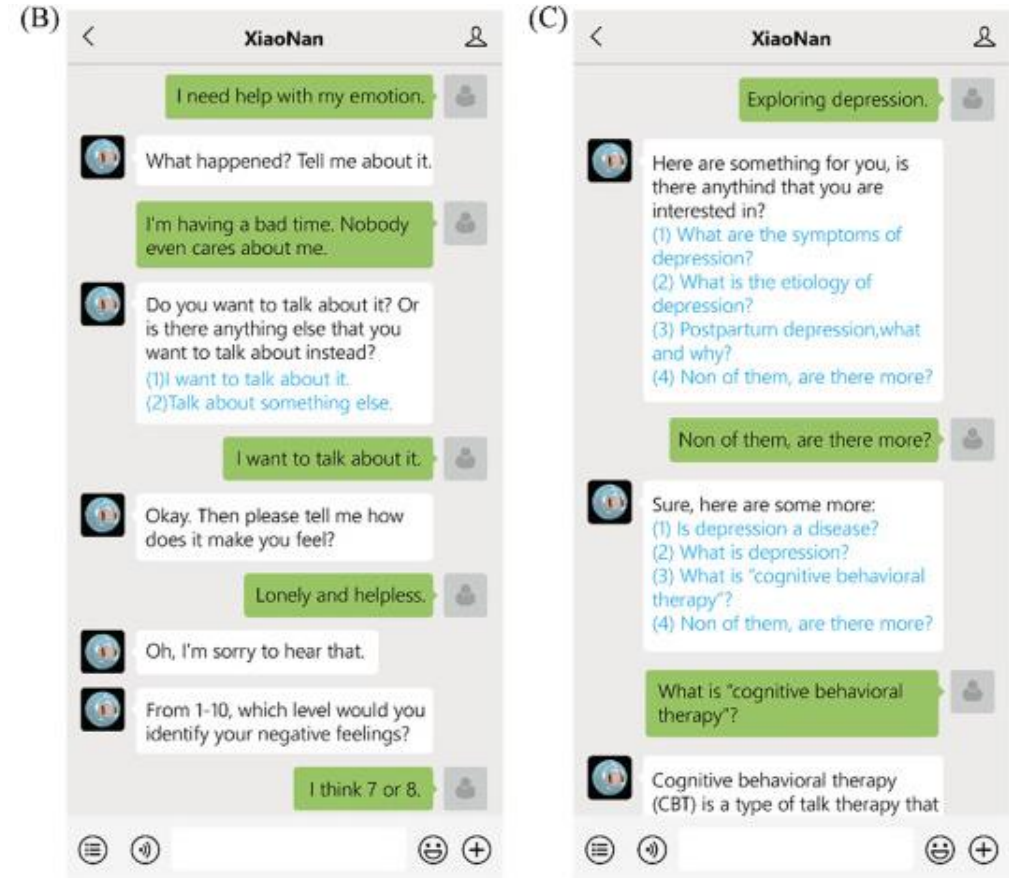
CHATBOTS

Chatbot coaching

Case of the XiaoNan chatbot

Developed as an alternative to bibliotherapy in a self-help mental health care plan.

Tested in a clinical trial against commonly accepted treatment for moderate depression and anxiety.



Hao Liu, Huaming Peng, Xingyu Song, Chenzi Xu, and Meng Zhang. 2022. Using AI chatbots to provide self-help depression interventions for university students: A randomized trial of effectiveness. *Internet Interventions* 27 (2022) 100495

CHATBOTS

Demographics of participants and variables at baseline (T₀).

| Empty Cell | Chatbot test group ^a | Bibliotherapy control group ^a | χ^2/t | <i>P</i> |
|---------------------------|---------------------------------|--|------------|----------|
| Age (years) | 23.41 (1.77) | 22.76 (1.70) | 1.69 | 0.09 |
| Gender | | | | |
| Male | 17 (41.46) | 20 (47.62) | 0.32 | 0.57 |
| Female | 24 (58.54) | 22 (52.38) | | |
| Education (years) | 17.29 (1.78) | 16.62 (1.65) | 1.77 | 0.08 |
| Scale, mean (SD) | | | | |
| Depression (PHQ-9) | 13.17 (3.32) | 13.59 (4.44) | 0.49 | 0.63 |
| Anxiety (GAD-7) | 15.59 (3.70) | 16.69 (3.77) | 1.33 | 0.19 |
| Positive affect | 28.17 (8.49) | 27.24 (9.39) | 0.47 | 0.64 |
| Negative affect | 27.07 (9.60) | 28.10 (8.92) | 0.50 | 0.62 |

ITT analysis at T₅.

| Empty Cell | Chatbot test group | | Bibliotherapy control group | | <i>F</i> | <i>P</i> | <i>d</i> ^c |
|------------------------|-----------------------------|--------------------|-----------------------------|--------------------|----------|----------|-----------------------|
| | T ₅ ^a | 95%CI ^b | T ₅ ^a | 95%CI ^b | | | |
| PHQ-9 | 7.92 (0.48) | 6.98–8.86 | 10.61 (0.53) | 9.54–11.68 | 22.89 | <0.01** | 0.83 |
| GAD-7 | 14.23 (0.34) | 13.56–14.89 | 14.97 (0.42) | 14.11–15.84 | 5.38 | 0.02* | 0.30 |
| Positive affect | 28.29 (0.27) | 27.76–28.83 | 28.65 (0.37) | 27.87–29.43 | 2.77 | 0.10 | 0.17 |
| Negative affect | 27.80 (0.77) | 26.28–29.31 | 27.27 (1.12) | 24.80–19.75 | 3.53 | 0.64 | 0.08 |

Hao Liu, Huaming Peng, Xingyu Song, Chenzi Xu, and Meng Zhang. 2022. Using AI chatbots to provide self-help depression interventions for university students: A randomized trial of effectiveness. *Internet Interventions* 27 (2022) 100495

CHATBOTS

Chatbot coaching

Some other cases:

Chatbot for smoking cessation (Olano-Espinosa, 2022).

Patients in the chatbot group had a higher rate of abstinence. This was correlated with the time spent interacting with the chatbot.

Chatbot to help overweight people trying to decrease their weight (Stein & Brooks, 2017).

Decrease comparable to transnational diabetes prevention programs (2,38% of initial weight lost during the year).

Eduardo Olano-Espinosa, Jose Francisco Avila-Tomas, Cesar Minue-Lorenzo, Blanca Matilla-Pardo, María Encarnación Serrano Serrano, F Javier Martinez-Suberviola, Mario Gil-Conesa, and Isabel Del Cura-González. 2022. Effectiveness of a Conversational Chatbot (Dejal@bot) for the Adult Population to Quit Smoking: Pragmatic, Multicenter, Controlled, Randomized Clinical Trial in Primary Care. JMIR Mhealth Uhealth 10, 6 (27 Jun 2022), e34273.

Natalie Stein and Kevin Brooks. 2017. A Fully Automated Conversational Artificial Intelligence for Weight Loss: Longitudinal Observational Study Among Overweight and Obese Adults. JMIR Diabetes 2, 2 (01 Nov 2017), e28.



A CHATBOT TO FIGHT CLIMATE CHANGE?

In consequence, we suggest that using a chatbot to help mitigate our CO2 emissions could be an interesting tool.

Following elements in the literature, we consider that both script-based and generative aspects have a place.

Script-based to provide activities and interact in a goal-oriented fashion.

Generative to avoid repetitiveness and build trust with chit-chat.

CHATBOT TO FIGHT CLIMATE CHANGE

Dealing with user interaction

An important aspect of a chatbot is how the user can interact with them.

- Text input
- Buttons
- Voice

Using buttons instead of text/voice input is not detrimental to the therapeutic alliance for other chatbots and can in fact be better, especially for the first interactions with the chatbot (Mai et al. 2022).



Vanessa Mai, Caterina Neef, and Anja Richert. 2022. "Clicking vs. writing"—The impact of a chatbot's interaction method on the working alliance in AI-based coaching. *Coaching | Theorie & Praxis* 8 (2022), 15–31.

CHATBOT TO FIGHT CLIMATE CHANGE

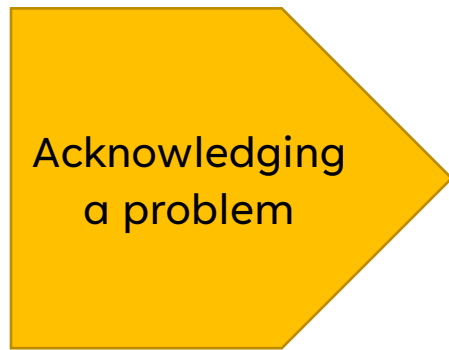
Activities

To promote behavior changes, we need to implement activities to raise the user's awareness that their actions can have global consequences.



CHATBOT TO FIGHT CLIMATE CHANGE

Acknowledging a problem



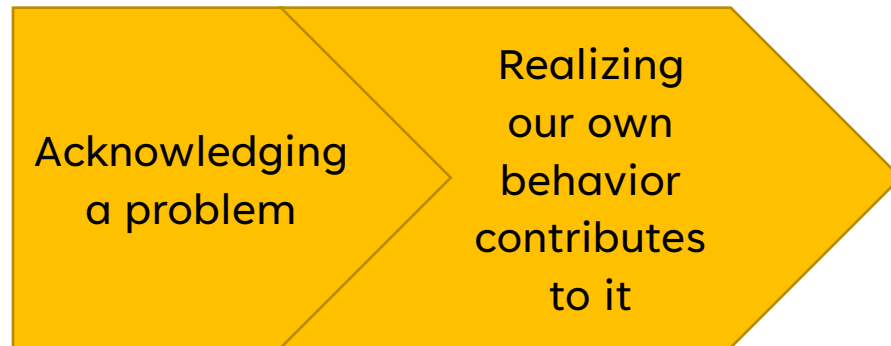
It is fair to assume that, today, users would be familiar with the problems related to climate change.

Still, to promote a change of behavior, awareness to specific topics can be raised by visualizing real-world data (melting glaciers, mass extinctions, etc...)

The chatbot should provide these activities and engage in discussions with the user following these activities.

CHATBOT TO FIGHT CLIMATE CHANGE

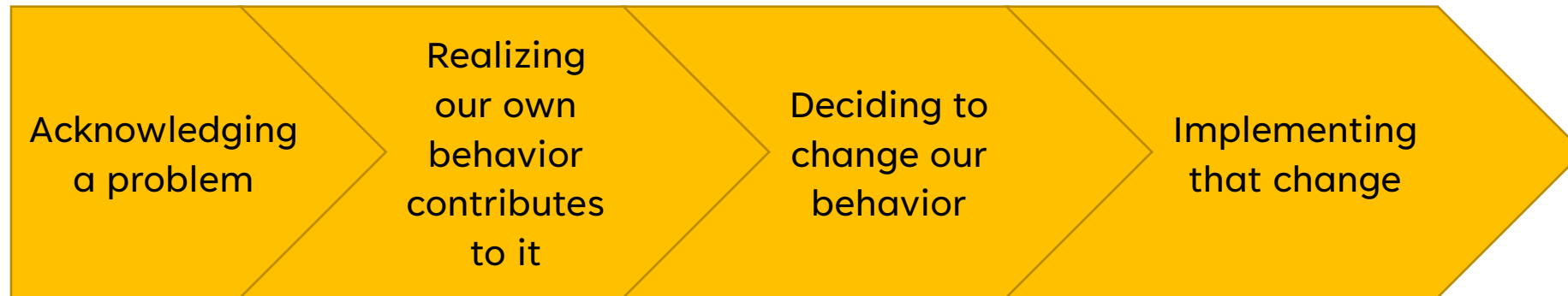
Acknowledging a problem



Users need to realize that their own behavior has an effect. This can be done by suggesting activities that show how individuals can have a global impact, such as activities around the “tragedy of commons”.

CHATBOT TO FIGHT CLIMATE CHANGE

Acknowledging a problem



Implementing that change requires an awareness of the different solutions available.

The chatbot should provide activities promoting critical thinking.

The chatbot should also provide activities to search for reliable sources of information.

CHATBOT TO FIGHT CLIMATE CHANGE

Acknowledging a problem



Once changes are decided, the chatbot should keep track of the progress made in the long term.

The chatbot should provide activities to remind the user of certain tasks, and monitor the user's activities (driving, etc...)

The calculation of a daily, weekly, monthly and yearly CO2 Budget to give the user feedback on the effectiveness of their changes, and rewards.



CONCLUSION

Chatbots are useful tools to change behavior. We believe one could be used to implement individual changes to reduce our carbon footprint.

It is also important to consider the social aspects of behavior change. People are usually not isolated and will communicate what they learn.

Thus it is not necessary for such a chatbot to be used by everyone, as long as a « critical mass » is reached.

HAR CONFERENCE

Workshop Erasmus

We are organizing a workshop dedicated to behavior change in climate change at our international conference from 19th to 22nd !

Accepted articles will be published in Lecture Notes in Computer Sciences (Springer).

Deadline on the 15th of June.

<http://har-conf.eu>