# A Conversational Agent for Argument-driven E-participation

Andrés Segura-Tinoco[1], Andrés Holgado-Sánchez[1], Iván Cantador[1],
María E. Cortés-Cediel[2], Manuel Pedro Rodríguez Bolívar[3]

[1] Escuela Politécnica Superior
Universidad Autónoma de Madrid
Madrid, Spain
andres.segurat@uam.es,
andres.holgado@estudiante.uam.es,
ivan.cantador@uam.es

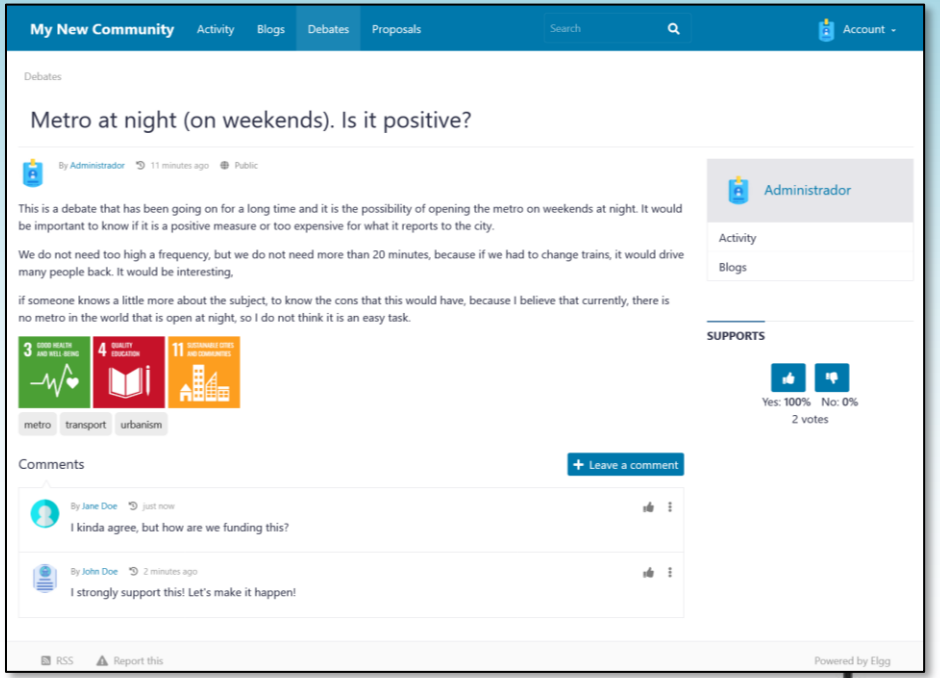
[2] Facultad de Ciencias Políticas y Sociología
Universidad Complutense de Madrid
Pozuelo de Alarcón, Spain
mcorte04@ucm.es

[3] Facultad de Ciencias Económicas y Empresariales
Universidad de Granada
Granada, Spain
manuelp@ugr.es

23rd Annual International Conference on Digital Government Research (dg.o 2022)
15-17 June 2022, Seoul, South Korea

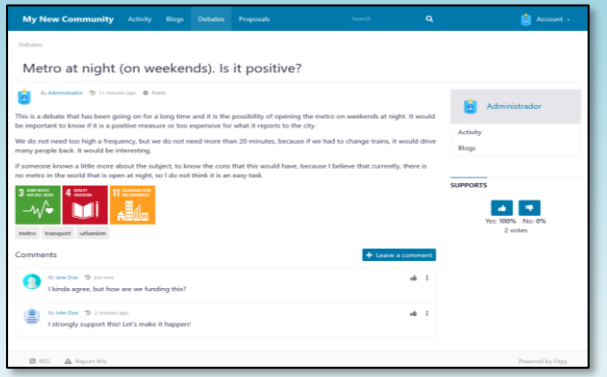
# E-participation

- **E-participation** –understood as the computer-assisted support to citizen collaboration– has originated novel consultation and deliberation processes
- Most current **e-participation platforms** are based on **web forums**
  - Citizens make proposals and provide comments and opinions, forming large conversation threads
- Recent attention has shifted to social media, especially social networks –e.g., Facebook and Twitter– and **instant messaging tools**, such as **Telegram** and **WhatsApp**

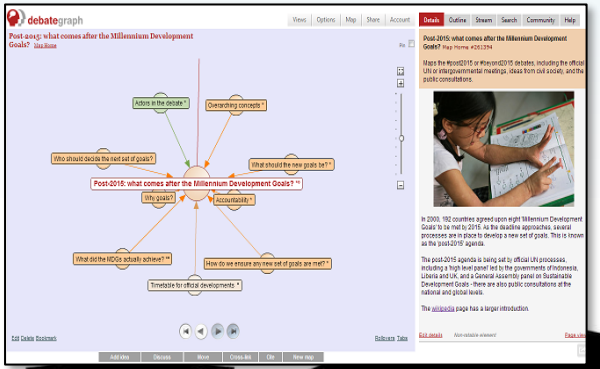


# E-participation platforms

- **Conventional web forums** promote social interaction
  - **Pros**
    - Easy and fast content generation (through free text posts)
    - Smooth, large-scale interaction (via comment threads)
  - **Cons**
    - No or very limited functionalities for content organization, filtering and analysis
    - Challenging moderation and processing of debate results
    - Dispersed and redundant content, since it is structured by *time*

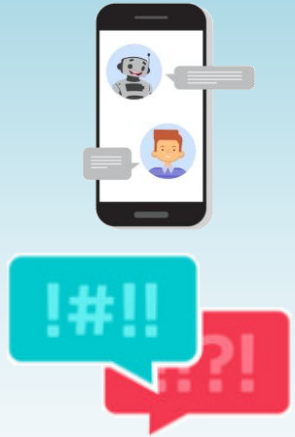



- **Argument-driven tools** promote the production and reuse of collective knowledge



# Motivation and goal

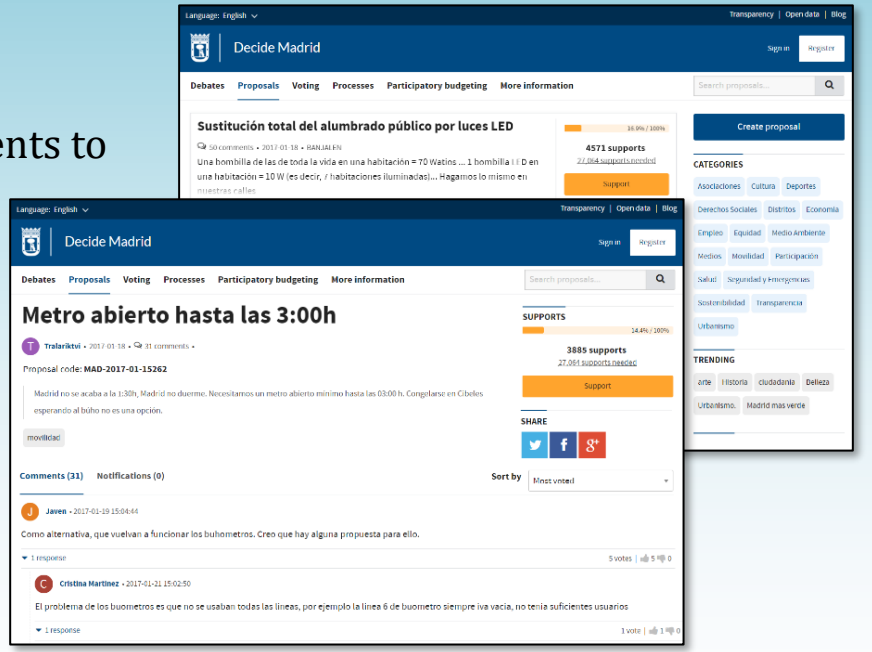
- **Our work on e-participation…**
  - **addresses two promising research lines**
    - The use of **conversational agents** or chatbots as citizen-to-government communication channels in instant messaging applications
    - The exploitation of **argument mining** techniques to automatically extract and present argumentative information from citizen-generated content
  - **targets a final goal**
    - Helping on finding out and **understanding city problems and citizens' concerns**, and consequently on getting well-formed opinions for making better decisions in participatory processes



# Case study

- **The 'Decide Madrid' e-participation platform**
  - A web system designed to allow Madrid residents to make, debate and vote proposals for the city

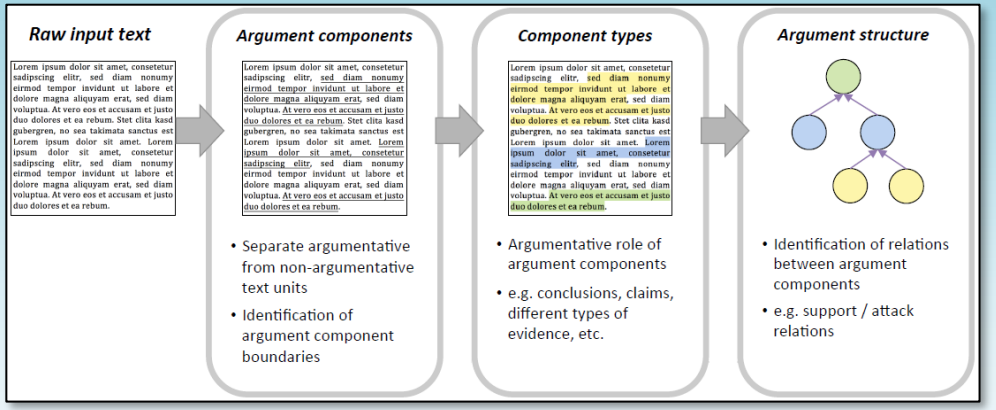
- Available data for a **citizen proposal**
  - Title
  - Author, date
  - Summary, description
  - Freely-chosen tags
  - User comment threads




- Heterogeneous **topics** and **debates**
  - Urbanism, transport, environment, health care, education, social rights, education, culture, economy, job, politics, security, housing, family, old age, religion, animals, etc.

# Argument mining

- **Tasks**
  - Detection of argument text fragments
  - Identification of argument components
  - Extraction of argument relations
- **Algorithmic foundations**
  - **Natural Language Processing (NLP)**
  - **Machine/deep learning**




Source: ACL'16 tutorial "NLP Approaches to Computational Argumentation"

- **Linguistic features**
  - **Sentence-level features**, e.g., sentence length, constituency tree depth, argument linkers, etc.
  - **Grammatical word categories**, e.g., number of nouns, modal verbs, etc.
  - **Syntactic patterns**

# Argument extraction method (I)

- **Argument model**
  - **Premise → Claim → Major claim**
- **Types and subtypes of argument relations**
  - **Cause**: linking an argument that reflects the reason or condition for another argument
  - **Clarification**: introducing a conclusion, exemplification, restatement or summary of an argument
  - **Consequence**: evidencing an explanation, goal or result of a previous argument
  - **Contrast**: attacking arguments, distinguishing between giving alternatives, doing comparisons, making concessions, and providing oppositions
  - **Elaboration**: introducing an argument that provides details about another one, entailing addition, precision or similarity issues about the target argument

# Argument extraction method (II)

- **Example of an extracted argument tree**

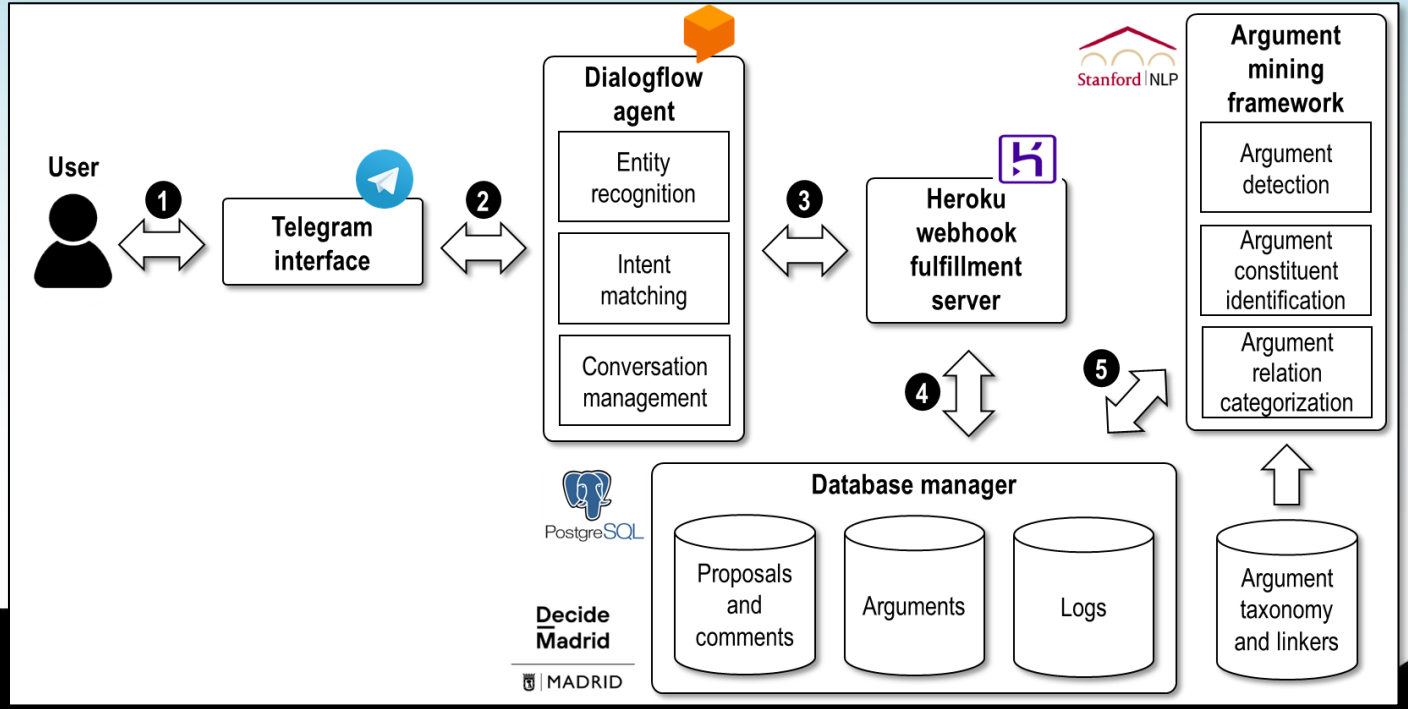
```
> Root argument [depth level 0]:
  MC: Massive tree planting in Madrid.

  - Argument reply [depth level 1]:
    C: Planting trees native to the Madrid region.
    L: {linker: 'to', intent: 'support', type: 'CONSEQUENCE', subType: 'GOAL'}
    P: Improve air quality, maintain a natural lifestyle and improve urban aesthetics with living beings.

    - Argument reply [depth level 2]:
      C: The first thing they should do is to stop cutting down healthy trees.
      L: {linker: 'as', intent: 'support', type: 'CAUSE', subType: 'REASON'}
      P: They are doing in Manzanares neighborhood.

    - Argument reply [depth level 2]:
      C: More than 230 trees in 3 weeks with the excuse that they are very dangerous and will fall on us.
      L: {linker: 'but', intent: 'attack', type: 'CONTRAST', subType: 'OPPOSITION'}
      P: When they started cutting down, only 4 of the 230 were hollow inside.

    - Argument reply [depth level 2]:
      C: Then they talk to us about contamination.
      L: {linker: 'but', intent: 'attack', type: 'CONTRAST', subType: 'OPPOSITION'}
      P: It is a lie, an incongruity and a nonsense.

      - Argument reply [depth level 3]:
        C: If only the trees they cut down were replaced by younger ones.
        L: {linker: 'but', intent: 'attack', type: 'CONTRAST', subType: 'OPPOSITION'}
        P: That is not the case.

        - Argument reply [depth level 4]:
          C: When an old tree falls on people it is a catastrophe.
          L: {linker: 'but', intent: 'attack', type: 'CONTRAST', subType: 'OPPOSITION'}
          P: We know that for years the care of the trees has not been controlled.
```

# Chatbot interaction

- Through a **natural language conversation** with the chatbot, the user:
  1. explores citizen **proposals** and **comments**, organized by categories, topics and districts
  2. accesses to categorized citizens' **arguments** given in the debates around a proposal
  3. provides **feedback** and **votes** for proposals

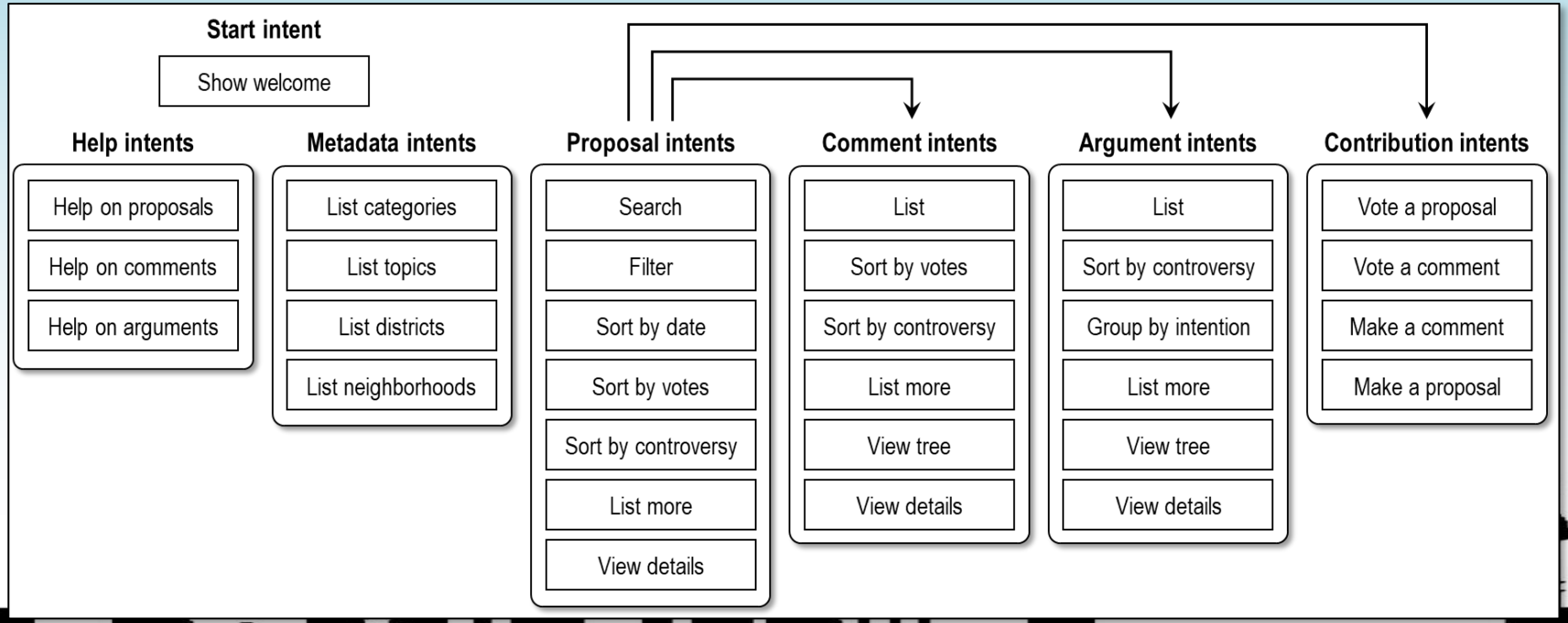
# Chatbot architecture

- The chatbot is built upon the **Google DialogFlow** framework, which links external web services with a variety of **instant messaging and social networking services**, e.g., Google Assistant, Facebook Messenger, WhatsApp, Telegram and Skype



# Chatbot conversation flow

- The chatbot handles several **conversation intents**, each of them with triggering **sentence patterns** and associated **functionalities**



# User study

- **Empirical evaluation of the chatbot in terms of:**
  1. The feasibility of exploring e-participation content via a conversational interface (in mobile devices)
  2. The potential benefits of argument-driven information in e-participation
- **Uncontrolled, realistic scenario**
  - Without external supervision, participants freely tested the chatbot via Telegram during a period of one week, using their own Telegram accounts and mobile devices
- **32 participants → 2 groups**
  - **Control group**: having disabled the chatbot's argument-driven browsing functionalities
  - **Experimental group**: having enabled the chatbot's argument-driven browsing functionalities

# Evaluation

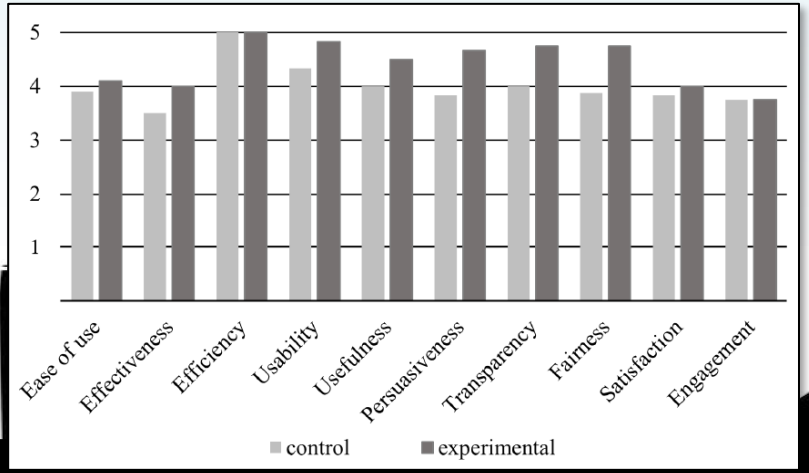
- **Objective metrics → effectiveness, efficiency**
  - Avg. number of sessions per participant
  - Avg. duration of session
  - Avg. number of actions per participant
- **Subjective questionnaires → citizen participation, decision making, public service values**
  - A questionnaire with 33 five-point Likert scale items addressing 10 evaluation criteria
    - Effectiveness, efficiency
    - Ease of use, usability
    - Usefulness, satisfaction, engagement
    - Transparency, fairness, persuasiveness

# Results (detailed in the paper)

- **Objective metrics**

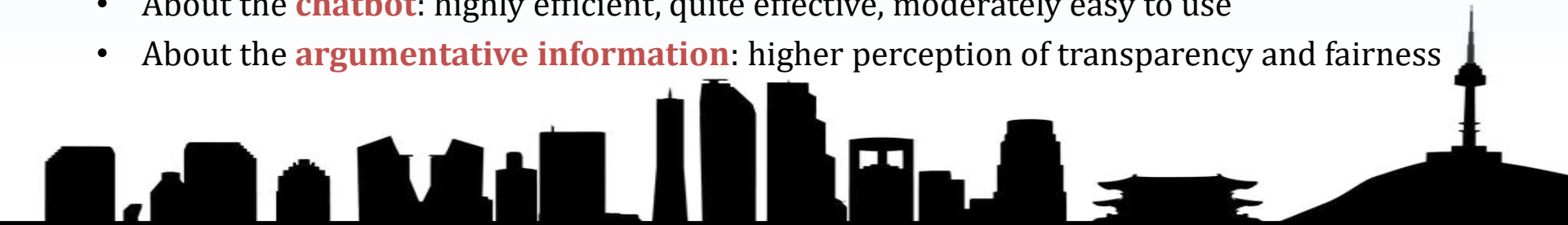
| | control group | experimental group |
|---|---|---|
| ***avg. number of sessions per user*** | 2.8 | 2.8 |
| ***avg. duration of session (in minutes)*** | 16.0 | 23.3 |
| ***avg. number of actions per user*** | 56.8 | 64.9 |
| *ask for help* | 13.5 | 10.8 |
| *list categories/topics/districts/neighborhoods* | 6.4 | 7.2 |
| *filter proposals* | 8.0 | 15.6 |
| *sort proposals* | 2.7 | 2.1 |
| *explore proposals* | 11.3 | 9.8 |
| *explore comments* | 7.6 | 6.7 |
| *explore arguments* | - | 7.4 |
| *provide feedback (new vote/comment/proposal)* | 1.7 | 2.1 |

- **Subjective questionnaires**



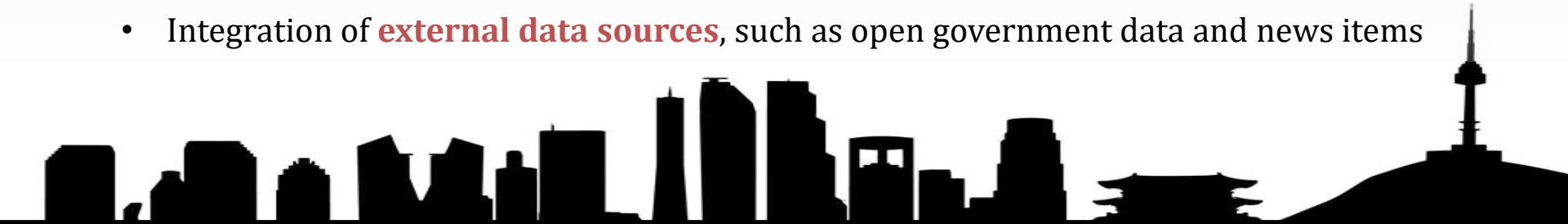
# Main findings

- **More user activity**
  - No significant difference on the avg. number of sessions per user (between groups)
  - Longer sessions in the control group
    - Increase of **45.6%** on the avg. session duration (from 16.0 to 23.3 minutes)
- **Higher user persuasiveness and engagement**
  - Increase of **14.3%** (from 56.8 to 64.9) on the avg. number of actions per user
  - Increase of **23.5%** (from 1.7 to 2.1) on the avg. number of feedback actions per user
  - Meaningful exploration of arguments (avg. 7.4 actions per user)
- **Better user opinions**
  - About the **chatbot**: highly efficient, quite effective, moderately easy to use
  - About the **argumentative information**: higher perception of transparency and fairness



# (Some) Open issues

- **Participants' suggestions**
  - A more "natural" conversation with the chatbot
  - A more fluent transition between browsed proposals
  - Facilities to read proposals with large descriptions
- **Future research directions**
  - **Personalized recommendation** mechanisms to proactively present relevant content to the user, thus mitigating the information overload problem
  - Richer data structures, analysis and visualizations for facilitating **decision making**
  - Functionalities oriented to **citizen collaboration**
  - Integration of **external data sources**, such as open government data and news items



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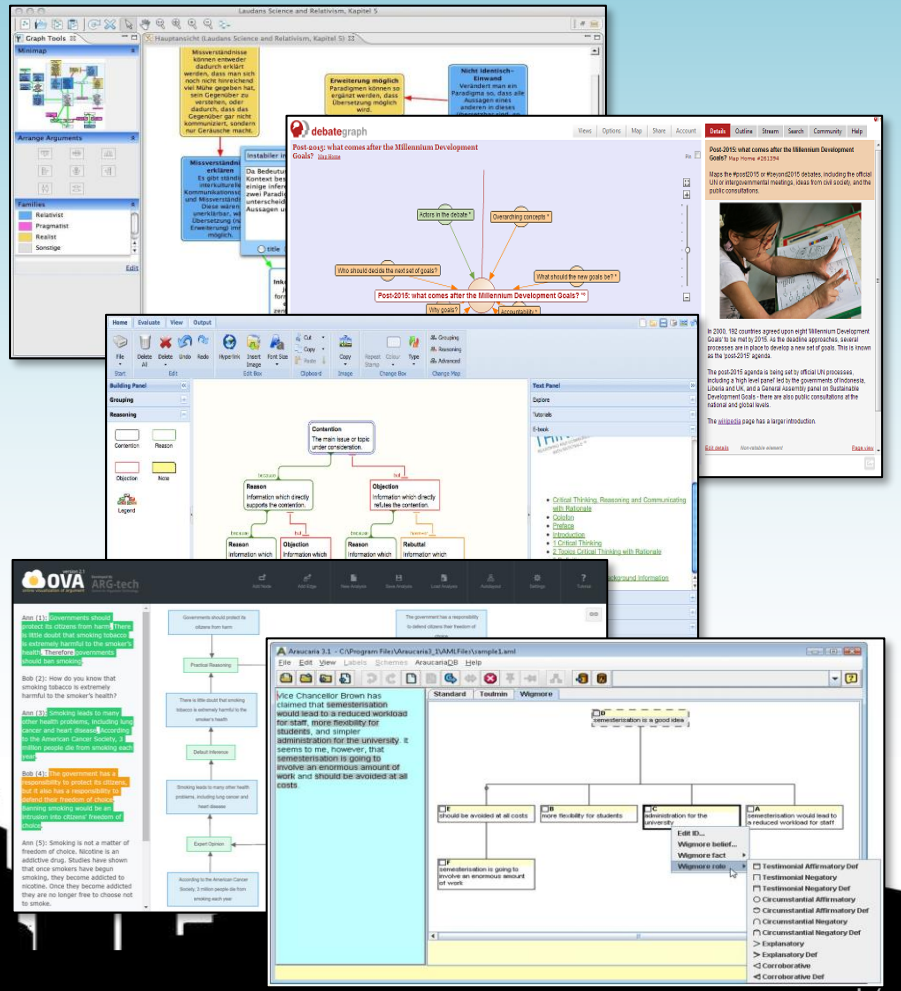
# Argument mining

- Tools
  - **Collaborative editors of argumentative graphs**
    - Agora, http://agora.gatech.edu
    - Argunet, http://www.argunet.org
    - DebateGraph, http://debategraph.org
    - Rationale Online, https://www.rationaleonline.com
  - **Argumentative annotation platforms**
    - Araucaria, http://araucaria.arg.tech
    - OVA, http://ova.arg-tech.org



# Argument extraction method

- **Argument linkers**

| Type | Subtype | Intent | English linkers | | Spanish linkers | |
|---|---|---|---|---|---|---|
| | | | *no.* | *examples* | *no.* | *examples* |
| *Cause* | *Condition* | qualifier | 30 | if [ever/so], in case of/that | 33 | si [alguna vez/es así], en caso de/que |
| | *Reason* | support | 16 | because [of], due to, since | 16 | porque, ya que, debido a [que], pues |
| | | | **46** | | **49** | |
| *Clarification* | *Conclusion* | support | 18 | to conclude, in/as conclusion | 21 | para concluir, en/como conclusión |
| | *Exemplification* | support | 8 | for [example/instance], as an example [of] | 12 | por ejemplo, como ejemplo [de] |
| | *Restatement* | support | 6 | in other words, that is [to say] | 26 | en otras palabras, es decir, esto es |
| | *Summary* | support | 12 | summarizing, summing up, to sum up | 7 | resumiendo, concluyendo, para acabar |
| | | | **44** | | **66** | |
| *Consequence* | *Explanation* | support | 6 | actually, in [actual] fact, indeed | 6 | realmente, de hecho, en realidad |
| | *Goal* | support | 19 | for, to, in order to, aimed/aiming to | 15 | para, por, con el fin de |
| | *Result* | support | 21 | therefore, thus, hence, then, so [that] | 40 | por [lo] tanto, por consiguiente/ende |
| | | | **46** | | **61** | |
| *Contrast* | *Alternative* | support/attack | 21 | on the other hand, in another case | 26 | por otra parte, por otro lado, en otro caso |
| | *Comparison* | support/attack | 7 | while, whereas, compared [to/with] | 17 | mientras [que], comparado con |
| | *Concession* | attack | 16 | although, [even] though, despite [that] | 28 | aunque, aún/incluso [si/así], a pesar de |
| | *Opposition* | attack | 22 | but, however, nonetheless, albeit | 31 | pero, sin embargo, no obstante |
| | | | **66** | | **102** | |
| *Elaboration* | *Addition* | support | 15 | also, besides, as well, too, moreover | 17 | también, además/aparte [de], [lo que] es más |
| | *Precision* | support | 11 | in particular, particularly, especially | 13 | en particular, particularmente, especialmente |
| | *Similarity* | support | 8 | similarly/analogously [to], like, likewise | 10 | similarmente/análogamente [a], como, al igual que |
| | | | **34** | | **40** | |
| | | *Total* | 236 | | 318 | |

# Study questionnaire

- **33 items**
- **10 evaluation criteria**
  - Citizen participation
  - Decision making
  - Public values

| Criterion | Questionnaire item |
|---|---|
| *Ease of use* | I1: The chatbot is easy to use |
| | I2: The interaction with the chatbot does not require a lot of mental effort |
| | I3: The help documentation of the chatbot is easy to understand |
| | I4: The help documentation of the chatbot is complete |
| | I5: The help documentation of the chatbot is valuable |
| *Effectiveness* | I6: The chatbot understands the user's questions and commands |
| | I7: The chatbot gives correct responses to the user's requests |
| *Efficiency* | I8: The chatbot is ready to interact soon after invocation |
| | I9: The chatbot provides responses quickly |
| *Usability* | I10: The chatbot allows exploring the citizen proposals about certain topic |
| | I11: The chatbot allows exploring the content of a citizen proposal |
| | I12: The chatbot allows exploring the pros and cons of a citizen proposal |
| *Usefulness* | I13: The chatbot allows finding out the city problems and citizens' concerns |
| | I14: The chatbot allows understanding others' ideas and opinions about citizen proposals |
| | I15: The chatbot allows getting well-formed opinions and making better decisions in the participatory process |
| *Persuasiveness* | I16: The chatbot promotes rethinking initial opinions about citizen proposals |
| | I17: The chatbot promotes commenting on citizen proposals |
| | I18: The chatbot promotes making own proposals for the city |
| *Transparency* | I19: The chatbot allows exploring a representative sample of citizen proposals |
| | I20: The chatbot allows exploring a representative sample of citizen comments and opinions in the citizen debates |
| *Fairness* | I21: The chatbot allows exploring an unbiased sample of citizen proposals |
| | I22: The chatbot allows exploring an unbiased sample of citizen comments (opinions) in the debates |
| | I23: The chatbot allows getting informed about controversial issues in the city |
| | I24: The chatbot allows getting informed about city issues affecting to minority or discriminated groups |
| *Satisfaction* | I25: I am satisfied with the functionalities provided by the chatbot |
| | I26: I am satisfied with the interaction (communication) offered by the chatbot |
| | I27: I am satisfied with the current version of the chatbot |
| *Engagement* | I28: I liked using the chatbot as a citizen participation tool |
| | I29: I enjoyed using the chatbot |
| | I30: I would use the chatbot again |
| | I31: I would recommend the chatbot to other people |
| | I32: I am going to enter into the Decide Madrid platform |
| | I33: I am going to search for information about (electronic) citizen participation initiatives |

# 32 participants

- **Gender**: 22 male, 10 female
- **Ages**: 18-29 years old (12), 30-39 years old (9), 40-49 years old (5), 50-59 years old (4), more than 59 years old (2)
- **Education levels**: secondary education (3), vocational education (1), Bachelor's degree (20), Master's degree (6), Doctoral degree (2)
  - Those with Higher Education levels had studied Sciences (3), Social Sciences (10), Arts and Humanities (4), and Engineering (11) careers
- Diverse levels of **knowledge/expertise on chatbots** –null knowledge and expertise (5), null expertise (5), low expertise (20), medium expertise (2)
- Diverse levels of **knowledge on citizen participation** –null (7), low (16), medium (9)

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Pozuelo de Alarcón, Spain
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