Towards Building Economic Models of Conversational Search

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There have been various models of conversational search (CS) proposed: Theoretical (Craswell and Radlinski, 2017), Conceptual (Azzopardi, et al, 2018), & Empirical (Vakulenko, et al, 2019)
Core to CS is the interaction between the user and the agent to refine the requests or elaborate on the request -- to seek out specific information or more information about the topic.

In Vakulenko et al (2019), the QFRA model involves querying, receiving/requesting feedback (RF) and Assessing (A) -- where they empirically discover two common conversational patterns.

1. Requesting **Feedback First** to refine the current request
2. Requesting **Feedback After** to refine/revise the subsequent request.

In this work, we proposed to model these pure conversational strategies using Economic Theory -- extending the standard economic model of search by Azzopardi (2014) -- where we model the costs and gains of the different interactions.

$Gain = G\ (Q, A, RF)$

$Cost = C(Q, A, RF)$

Feedback First

Sup?

I would like to know about Barack Obama?

Would you like to know about his time as president, his family, his career, or something else?

His time as president.

Here are some results about Barack Obama's Time as President.
...

Feedback After

Sup?

I would like to know about Barack Obama?

Here are some results about Barack.
...

Would you like to know more about his time as president, his family, his career, or something else?

Which conversational pattern/strategy is better?
How much feedback should be given before and/or after?

(See paper for the math where we created two models for each pure conversational strategy -- and optimised to minimize the cost for a given amount of gain.)

Feedback First

- If the cost of feedback increases
  → user should assess more items per query
  - As the user is investing more in a better query (more gain)

C_f

- If the cost of querying increases or the cost of assessing increases
  → user/system should provide/request more feedback.
  - As improving the query, leads to finding answers quicker

C_q
C_a

- The greater the feedback improves the original query
  → the less feedback that is required.
  - More feedback → more cost, but not necessarily more gain.

γ_1

- If the original query is of sufficient quality, or
- If feedback leads to small or no improvements to the original query,
  → Less / no feedback is warranted
  - Asking for feedback is not worthwhile the additional cost.

γ_1

Feedback After

- If the cost of giving feedback increases
  → users will tend issue more queries
  → users will tend examine more items per round of feedback
  - As the user is investing more in the feedback process
- If the cost of querying increases
  → users will increase the number of rounds of feedback given
  - Giving feedback become more attractive relative to querying
- As the relative efficiency of feedback increases
  → users will increase the number of rounds of feedback given
  - Feedback is the natural alternative to querying
- The optimal amount of feedback after to querying will depend on the relative costs and relative efficiencies of querying and giving feedback.

Take home: When is "Conversational Search" Economically Viable?

Whether to give or request feedback first (before) or after depends on the relative costs and efficiencies of each action.
For feedback first, the feedback needs to be **cheaper and more effective**.
If the original query or revised query is already highly effective, feedback only increases the cost to the user.
For feedback after, the feedback needs to **cheaper and/or more effective** than issuing a query.

*Also results are theoretical and so empirical work is required. * While, these are pure strategies and in practice mixed strategies will be undertaken.
*See our paper from CIKM 2021 for our computational analysis comparing strategies (scan the QR code).