

Exploring Social Metacognition: the role of confidence in updating estimates of advisor reliability with and without feedback.

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Wolfson College
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*A thesis submitted for the degree of
Doctor of Philosophy*

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Abstract

This *R Markdown* template is for writing an Oxford University thesis. The template is built using Yihui Xie's `bookdown` package, with heavy inspiration from Chester Ismay's `thesisdown`, and the `OxThesis` L^AT_EX template (most recently adapted by John McManigle).

This template's sample content include illustrations of how to do the various things you need to write a thesis in R Markdown, and largely follow the structure from this R Markdown workshop.

Congratulations for taking a step further into the lands of open, reproducible science, by writing your thesis using a tool that allows you to transparently include tables and dynamically generated plots directly from the underlying data. Hip hooray!

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For TBC

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Ulrik Lyngs
Linacre College, Oxford
2 December 2018

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- 1-D, 2-D** . . . One- or two-dimensional, referring in this thesis to spatial dimensions in an image.
- Otter** One of the finest of water mammals.
- Hedgehog** . . . Quite a nice prickly friend.

Part I

Introduction

1

Introduction

This thesis attempts to determine whether individual psychological processes in the seeking and taking of advice are sufficient to produce entrenched biases at the network level. The work includes empirical investigation into the individual psychological processes underlying advice seeking and advice taking using behavioural experiments; computational modelling and behavioural experimentation exploring the effects of contextual factors on advice-taking; agent-based computational modelling of the effects interactions between agents with psychological advisor evaluation processes that produce biases in assimilation of information and source selection; and a comparison between the structures of networks produced in these models and those naturally occurring social networks. The organisation is as follows: this introduction establishes the core concepts invoked in this thesis, and describes their treatment in the literature; the following sections each include a short chapter on the specific question addressed and the techniques used, a detailed description of the work conducted, and a short discussion of the conclusions drawn from the work; and a final section offers broader conclusions arising as a consequence of the presented work, alongside some suggestions for related research.

Overview

The first line of behavioural experiments report investigates whether people decide which advisors to consult using internal signals where external feedback is unavailable, extending a previous finding concerning the influence of advice (Pescetelli and Yeung 2018) into the domain of advisor choice. While little support is found for the metacognitive mechanisms underpinning the influence of advice, the frequency of agreement is shown to be a good indicator of advisor choice. Next, the effects of advisor agreement are explored in terms of influence using a different decision-making domain; a date estimation rather than perceptual decision task. Again, people denied objective feedback on the quality of advice are shown to attend to agreement.

The work above demonstrates how the influence of advice depends upon the reputation of an advisor built up over time. In a second line of experiments, reputations of advisors are established at the outset and the responses to different pieces of advice are explored. People consider both the properties of advice and the properties of advisors, placing less trust in advice which appears suspicious or which comes from a suspicious source. These behavioural results support implications from evolutionary models which demonstrate that the presence of even a few bad actors in a population can mean that distrusting all advice from all sources a little is adaptive. The evolutionary models are extended to show that this kind of general distrust, known as egocentric discounting, emerges as adaptive even where none of the agents deliberately mislead others, and even where all agents are equally skilled and fully cooperative.

Finally, network effects arising from interconnected networks of agents are explored. Agents are based on the empirical results heretofore presented, and the consequences are explored for networks with various starting structures characterised by sparsity and homogeneity, under varying rates and reliabilities of external feedback. !TODO[results of this]. The resulting network characteristics are compared with network structures from real online networks from social media websites. !TODO[results of this].

Advice

Advice is broadly defined as information which comes from a social source. Advice is therefore different from other sources of information in that it is the result of (at least) mental processing of other information. In some cases, it may additionally include discussions among different group members (e.g. advice from the International Advisory Panel on Climate Change). Throughout this thesis, the focus is primarily on advice which comes from a single, stable source, as when we see a post by an acquaintance on social media, or when a stranger provides us with advice.

Advice-taking

Advice occurs in the context of a decision, and forms a part of the information which is integrated during the decision-making process to produce a decision. To the extent that the decision reached differs from the decision that would have occurred had the advice not been presented, the advice has had an effect on the decision; to the extent that this difference changes the decision in a way consistent with the advice, the advice has been ‘taken’ (as opposed to ‘rejected’).

It is tacitly implied by many operationalizations of advice-taking that the informational content of the advice determines the extent to which it is taken or rejected **citation needed**. Insofar as the identity of the advisor matters, it matters because it functions as a cue to the informational content of the advice. This is likely a major oversimplification, however, because in many real-world contexts advice-giving and advice-taking form part of a developing social relationship: being consulted for advice and having one’s advice followed are inherently rewarding (Hertz and Bahrami 2018; Hertz, Palminteri, et al. 2017); and taking advice can serve as a (sometimes costly) social signal of valuing a relationship with a person or group (Byrne et al. 2016). Furthermore, some authors have argued that people may perceive taking advice as sacrificing their independence or autonomy (**CITATIONNEEDED**)!TODO. While this thesis follows previous literature in omitting to consider the wider social concerns influencing the taking of advice,

it is nevertheless important to remember that the processes investigated herein take place in a variety of social contexts where complex social agents attempt to optimise over numerous goals over numerous timescales.

Three-factor model of trust

The degree to which advice is taken is proportional to the trust placed in the advisor by the decision-maker. Interpersonal trust, or the degree to which one is prepared to place one's fortune in the hands of another (e.g. by relying on their advice), is apportioned by Mayer et al. (1995) onto three properties of the advisor (as judged by the decision-maker): ability, benevolence, and integrity. To these three properties of the advisor we may add the decision-maker's general propensity to trust, as well as situational cues and task cues (e.g. the phenomenon that advice is more readily taken for hard tasks than easy ones, (Gino and Moore 2007)).

Ability

Ability captures the expertise of an advisor: their raw ability to perform the task for which they are giving advice. In some cases this is relatively straightforward, as in the expertise of a General Practitioner in matters of health and disease, and in others more complex, as in the expertise of a hairdresser when deciding on a haircut (when matters of personal taste comingle with aesthetic considerations of facial structure, practical considerations of hair constitution, and social considerations of fashion). The greater the ability of an advisor, the greater the influence of their advice, as demonstrated by experiments showing that participants' decisions are more affected by the advice of advisors who are labelled as more expert in a relevant domain (Sah et al. 2013; Schultze et al. 2017; Sniezek, Schrah, et al. 2004; Sniezek and Van Swol 2001; Soll and Mannes 2011), or are shown to be more expert empirically (Pescetelli 2017; Sah et al. 2013; Ilan Yaniv and Kleinberger 2000).

Benevolence

Benevolence refers to the extent to which the advisor seeks to further the interests of the decision-maker. Where ability represents the absolute limit on the quality of advice, benevolence represents the extent to which the advice approaches this limit. The advice of even a renowned expert may be doubted if there is reason to believe their goal is to mislead, a vital lesson for medieval monarchs with their councils of politicking advisors. Experimental work has shown that psychology students relied more on the advice of their friends than on the advice of labelled experts (CITATIONNEEDED)!TODO, and that participants are more inclined to reject advice when uncertainty is attributed to malice rather than ignorance (Schul and Peni 2015).

Integrity

Advisors with integrity exhibit adherence to principles which the decision-maker endorses. As with benevolence, integrity acts to determine the extent to which advice approaches the limit imposed by ability. While not mutually exclusive, integrity is typically important where relationships are less personal (e.g. we may place great trust in a General Practitioner because of their expertise in medical matters and their *integrity* in adhering to a set of professional ethical and conduct requirements). Some description of the research(CITATIONNEEDED)!TODO

Normative models of advice-taking

Advice-taking can be evaluated formally with reference to a normative model. The simplest and most common of these views the decision-making task as an estimation problem (or combination of estimation problems), and provides an approximately Bayesian variance-weighted integration of independent estimates. To borrow from Galton (1907), consider the task of judging the weight of a bullock. We can model any single guess (e) as the true weight (v) plus some error (ϵ):

$$e = v + \epsilon \quad (1.1)$$

The key insight is to observe that the error is drawn from a normal distribution ($\mathcal{N}(\mu = 0, \sigma^2)$)¹. As the number of samples from this distribution increases, the mean of those samples tends towards the mean of the distribution. Thus, the more estimates are taken, the closer on average the sum of errors will be to 0.

$$\frac{\sum_i^N(e_i)}{N} = \frac{\sum_i^N(v + \mathcal{N}(\mu = 0, \sigma_i^2))}{N} \quad (1.2)$$

$$\frac{\sum_i^N(e_i)}{N} = \frac{\sum_i^N(v)}{N} + \frac{\sum_i^N(\mathcal{N}(\mu = 0, \sigma_i^2))}{N} \quad (1.3)$$

$$\frac{\sum_i^N(e_i)}{N} = \frac{Nv}{N} + \hat{0} \quad (1.4)$$

$$\frac{\sum_i^N(e_i)}{N} \approx v \quad (1.5)$$

Observe that this formulation is true no matter the value of N . On average, it is always better to have more estimates than fewer. This suggests that, even in the situation where there are only two estimates (the decision-maker's and the advisor's), the best policy will be to incorporate both estimates into the final decision.

The variance of the normal distribution from which errors are derived (σ_i^2) is, in the example above, drawn from a normal distribution itself ($\sigma_i^2 \sim \mathcal{N}(\mu = 0, \text{sd}^2)$) meaning that it is also cancelled out on average over repeated samples). Where few estimates are taken, weighting those estimates by the variance of the error distributions will increase the accuracy of the estimates in proportion to the difference between the variances. Many experimental implementations of this model avoid weighting issues by calibrating decision-makers and advisors to be equally accurate on average ($\sigma_{\text{decision-maker}}^2 = \sigma_{\text{advisor}}^2$). The result of this constraint is that the optimal policy is simply to average all estimates together.

¹The normal distribution is well-supported by empirical evidence, but note that any symmetrical distribution around 0 will lead to the same conclusion.

Egocentric-discounting

From the perspective of the normative model above, decision-makers should weigh their own estimate equally with each other estimate they receive in the process of coming to their decision. One of the most robust findings in the literature on advice-taking is that people routinely underweight advisory estimates relative to their own estimates, a phenomenon known as *egocentric discounting* (Dana and Cain 2015; Gino and Moore 2007; Hütter and Ache 2016; Liberman et al. 2012; Minson and Mueller 2012; Rader et al. 2017; Ronayne and Sgroi 2018; See et al. 2011; Soll and Mannes 2011; Trouche et al. 2018; Ilan Yaniv and Kleinberger 2000; Ilan Yaniv and Choshen-Hillel 2012; Ilan Yaniv and Milyavsky 2007). Egocentric discounting occurs in both feedback and no-feedback contexts (Ilan Yaniv and Kleinberger 2000).

Explanations for egocentric discounting are usually framed in terms of personal-level psychology: decision-makers have better access to reasons for their decision (Ilan Yaniv and Kleinberger 2000); overrate their own competence (Snizek, Schrah, et al. 2004); may have a desire to appear consistent (Ilan Yaniv and Milyavsky 2007); may see opinions as possessions (Soll and Mannes 2011); may be loss-averse to providing a worse final estimate due to advice-taking (Soll and Mannes 2011); or have difficulty avoiding anchoring (Schultze et al. 2017) or repetition bias effects (Trouche et al. 2018). None of these explanations has survived rigorous empirical testing, however, and recently suggestions have widened to include consideration of aggregate-level rather than personal-level causes, with Trouche et al. (2018) arguing that the potential for misaligned incentives between decision-maker and advisor motivate discounting of advice.

In the course of this thesis **crossref needed**, I demonstrate that egocentric discounting may be a stable metastrategy which protects against exploitation, carelessness, incompetence, and miscommunication. From this perspective, the normative model pertains to a particular instantiation of a problem with questionable ecological validity given the typical ethology of advice-taking in humans. While such considerations affect the conclusions one draws from egocentric discounting relative

to the normative model, they do not detract substantially from the practice of using the normative model as an optimum ‘set point’ from which to evaluate advice-taking behaviour.

Evaluation of advice

The value of advice, in informational terms, is measured in relation to the optimal decision. It is necessary to distinguish two perspectives on the value of advice: the optimality of the decision recommended by the advice itself; and the optimality of the decision based on advice relative to the decision which would have been made had the advice not been received. This distinction is necessary because people alter their advice-giving behaviour in anticipation of discounting on the part of the decision-maker (**CITATIONNEEDED**; for a case in human-machine teaming see Azaria et al. 2016)!TODO, somewhat akin to starting negotiations with a higher demand than one is hoping to settle for.

A single piece of advice can be evaluated using its own properties and the properties of the advisor giving the advice. Furthermore, that evaluation can serve to update the properties of the advisor. A piece of advice’s own properties will include its plausibility (e.g. participants in estimation tasks discount advice which is distant from their own initial estimates more heavily (I. Yaniv 2004)), while the properties of the advisor will include the advisor’s trustworthiness (see above). The updating of trust following experience of advice is likely to be largely in the domain of ability, although other domains may be affected where the advice is particularly egregious.

Updating advisor evaluations

While a single piece of advice must be taken on its own terms, people can construct relatively accurate estimates of advisors’ advice when provided with feedback on the decisions they use the advice to make (Pescetelli 2017; Sah et al. 2013; Ilan Yaniv and Kleinberger 2000). This likely happens as an analogue of reinforcement learning, where feedback allows an error signal to be used to update the estimate of the

advisor's ability (\hat{s}^a) rather than one's own beliefs about the world, according to some learning rate (λ).

this is wrong; need to check RL models for an analogue (1.6)

$$\hat{s}_{t+1} = \hat{s}_t + |e_t^a - v| \cdot \lambda \quad (1.7)$$

Advisor evaluation without feedback

Where feedback is not available, participants in experiments continue to demonstrate an ability to respond rationally to differences in advisor quality (Pescetelli 2017). This is evidently not done through access to the correct real-world values, because feedback providing those values is unavailable, and, were participants aware of those values themselves, it stands to reason they would have provided those values (and thus not require advice!). Pescetelli and Yeung (2017) suggest the mechanism for this ability to discriminate between advisors in the absence of feedback is performing updates based on confidence-weighted agreement.

Agreement

Consider first the non-weighted agreement case, where the advisor's estimate at time t (e_t^a) and the decision-maker's estimates (e_t^d) are binary ($\in 0, 1$). The estimate of the advisor's ability (\hat{s}^a) is updated positively if the advisor and decision-maker agree, and negatively otherwise, according to the learning rate λ .

$$\hat{s}_{t+1}^a = \hat{s}_t^a + (-2 |e_t^d - e_t^a| + 1) \cdot \lambda \quad (1.8)$$

Confidence-weighted agreement

The updating of advice contingent on agreement may be weighted by confidence in the initial decision (c^d), such that agreement and disagreement are considered

more informative about the quality of the advice when the decision with which they agree or disagree is more certain.

$$\hat{s}_{t+1}^a = \hat{s}_t^a + (-2 |e_t^d - e_t^a| + 1) \cdot c_t^d \cdot \lambda \quad (1.9)$$

Continuous estimate case

Homophily and echo-chambers

Homophily is the ubiquitous phenomenon that individuals more closely connected to one another within a social network tend to be more similar to one another than would be expected by chance across numerous dimensions, from demographics to attitudes (McPherson et al. 2001). Whether homophily in virtual social networks is responsible for increases in polarisation is debated. Proponents point to increases in polarisation (e.g. in politics: **Pew Research Center, 2014!TODO**), to empirical studies demonstrating homophily in virtual social networks (Cardoso et al. 2017; Colleoni et al. 2014), and to studies examining selective exposure online (Kobayashi and Ikeda 2009), and to echo chambers: egregious examples of highly homophilous networks with pathological polarisation (Sunstein 2002; Sunstein 2018). The empirical components of the argument are contested, with evidence that virtual social networks are less homogenous than offline social networks (and hence depolarising, Barberá 2015), and that selective exposure is a somewhat dubious finding which does not show up clearly online (Garrett 2009a; Garrett 2009b; Nelson and Webster 2017; Sears and Freedman 1967). Modelling work demonstrates, however, that where there is a bias in assimilation of information, homophily exacerbates polarisation (Dandekar et al. 2013). Where polarisation in turn increases homophily, for example through selective exposure or avoidance, a self-reinforcing spiral emerges wherein social connections become increasingly homogenous and attitudes increasingly extreme (Song and Boomgaarden 2017).

Source selection and information weighting

Context-dependency of epistemic processes

Works Cited

- Azaria, Amos et al. (Jan. 2016). “Strategic Advice Provision in Repeated Human-Agent Interactions”. English. In: *Autonomous Agents and Multi-Agent Systems* 30.1. WOS:000370153000002, pp. 4–29.
- Barberá, Pablo (2015). “How Social Media Reduces Mass Political Polarization. Evidence from Germany, Spain, and the U.S.” en. In: p. 46.
- Byrne, Kaileigh A. et al. (Oct. 2016). “Ostracism Reduces Reliance on Poor Advice from Others during Decision Making”. English. In: *Journal of Behavioral Decision Making* 29.4. WOS:000383623700006, pp. 409–418.
- Cardoso, Felipe Maciel et al. (July 2017). “Topical Homophily in Online Social Systems”. en. In:
- Colleoni, Elanor, Alessandro Rozza, and Adam Arvidsson (Apr. 2014). “Echo Chamber or Public Sphere? Predicting Political Orientation and Measuring Political Homophily in Twitter Using Big Data: Political Homophily on Twitter”. en. In: *Journal of Communication* 64.2, pp. 317–332.
- Dana, Jason and Daylian M Cain (Dec. 2015). “Advice versus Choice”. en. In: *Current Opinion in Psychology* 6, pp. 173–176.
- Dandekar, Pranav, Ashish Goel, and David T. Lee (Apr. 2013). “Biased Assimilation, Homophily, and the Dynamics of Polarization”. en. In: *Proceedings of the National Academy of Sciences* 110.15, pp. 5791–5796.
- Galton, Francis (1907). “Vox Populi (the Wisdom of Crowds)”. In: *Nature* 75, pp. 450–451.
- Garrett, R. Kelly (Jan. 2009a). “Echo Chambers Online?: Politically Motivated Selective Exposure among Internet News Users”. en. In: *Journal of Computer-Mediated Communication* 14.2, pp. 265–285.
- (Dec. 2009b). “Politically Motivated Reinforcement Seeking: Reframing the Selective Exposure Debate”. en. In: *Journal of Communication* 59.4, pp. 676–699.
- Gino, Francesca and Don A. Moore (Jan. 2007). “Effects of Task Difficulty on Use of Advice”. en. In: *Journal of Behavioral Decision Making* 20.1, pp. 21–35.
- Hertz, Uri and Bahador Bahrami (Apr. 2018). “Intrinsic Value of Social Influence over Others”. In:
- Hertz, Uri, Stefano Palminteri, et al. (Dec. 2017). “Neural Computations Underpinning the Strategic Management of Influence in Advice Giving”. en. In: *Nature Communications* 8.1, p. 2191.
- Hütter, Mandy and Fabian Ache (2016). “Seeking Advice: A Sampling Approach to Advice Taking”. en. In: *Judgment and Decision Making* 11.4, p. 16.
- Kobayashi, Tetsuro and Ken’ichi Ikeda (Sept. 2009). “SELECTIVE EXPOSURE IN POLITICAL WEB BROWSING: Empirical Verification of ‘Cyber-Balkanization’ in Japan and the USA”. en. In: *Information, Communication & Society* 12.6, pp. 929–953.

- Liberman, Varda et al. (Mar. 2012). “Naïve Realism and Capturing the “Wisdom of Dyads””. en. In: *Journal of Experimental Social Psychology* 48.2, pp. 507–512.
- Mayer, Roger C., James H. Davis, and F. David Schoorman (1995). “An Integrative Model of Organizational Trust”. In: *Academy of management review* 20.3, pp. 709–734.
- McPherson, Miller, Lynn Smith-Lovin, and James M Cook (2001). “Birds of a Feather: Homophily in Social Networks”. In: *Annual Review of Sociology* 27.1, pp. 415–444.
- Minson, Julia A. and Jennifer S. Mueller (Mar. 2012). “The Cost of Collaboration: Why Joint Decision Making Exacerbates Rejection of Outside Information”. en. In: *Psychological Science* 23.3, pp. 219–224.
- Nelson, Jacob L. and James G. Webster (July 2017). “The Myth of Partisan Selective Exposure: A Portrait of the Online Political News Audience”. en. In: *Social Media + Society* 3.3, p. 205630511772931.
- Pescetelli, Niccolo (2017). “On the Use of Metacognitive Signals to Navigate the Social World”. DPhil. University of Oxford.
- Pescetelli, Niccolo and Nick Yeung (Sept. 2018). “The Role of Decision Confidence in Advice-Taking and Trust Formation”. In: *arXiv:1809.10453 [cs]*. arXiv: 1809.10453 [cs].
- Rader, Christina A., Richard P. Larrick, and Jack B. Soll (Aug. 2017). “Advice as a Form of Social Influence: Informational Motives and the Consequences for Accuracy”. en. In: *Social and Personality Psychology Compass* 11.8, n/a–n/a.
- Ronayne, David and Daniel Sgroi (2018). “Ignoring Good Advice”. In:
- Sah, Sunita, Don A. Moore, and Robert J. MacCoun (July 2013). “Cheap Talk and Credibility: The Consequences of Confidence and Accuracy on Advisor Credibility and Persuasiveness”. In: *Organizational Behavior and Human Decision Processes* 121.2, pp. 246–255.
- Schul, Yaacov and Noam Peni (Oct. 2015). “Influences of Distrust (and Trust) on Decision Making”. English. In: *Social Cognition* 33.5. WOS:000364258500004, pp. 414–435.
- Schultze, Thomas, Andreas Mojzisch, and Stefan Schulz-Hardt (May 2017). “On the Inability to Ignore Useless Advice: A Case for Anchoring in the Judge-Advisor-System”. en. In: *Experimental Psychology* 64.3, pp. 170–183.
- Sears, David O. and Jonathan L. Freedman (1967). “Selective Exposure to Information: A Critical Review”. In: *Public Opinion Quarterly* 31.2, pp. 194–213.
- See, Kelly E. et al. (Nov. 2011). “The Detrimental Effects of Power on Confidence, Advice Taking, and Accuracy”. In: *Organizational Behavior and Human Decision Processes* 116.2, pp. 272–285.
- Sniezek, Janet A., Gunnar E. Schrah, and Reeshad S. Dalal (July 2004). “Improving Judgement with Prepaid Expert Advice”. en. In: *Journal of Behavioral Decision Making* 17.3, pp. 173–190.
- Sniezek, Janet A. and Lyn M. Van Swol (Mar. 2001). “Trust, Confidence, and Expertise in a Judge-Advisor System”. In: *Organizational Behavior and Human Decision Processes* 84.2, pp. 288–307.
- Soll, Jack B. and Albert E. Mannes (Jan. 2011). “Judgmental Aggregation Strategies Depend on Whether the Self Is Involved”. en. In: *International Journal of Forecasting* 27.1, pp. 81–102.
- Song, Hyunjin and Hajo G. Boomgaarden (Apr. 2017). “Dynamic Spirals Put to Test: An Agent-Based Model of Reinforcing Spirals Between Selective Exposure, Interpersonal

- Networks, and Attitude Polarization”. en. In: *Journal of Communication* 67.2, pp. 256–281.
- Sunstein, Cass R. (2002). *Republic.Com*. en. Princeton University Press.
- (Apr. 2018). *#Republic: Divided Democracy in the Age of Social Media*. en. Princeton University Press.
- Trouche, Emmanuel et al. (Jan. 2018). “Vigilant Conservatism in Evaluating Communicated Information”. en. In: *PLOS ONE* 13.1. Ed. by Alexander N. Sokolov, e0188825.
- Yaniv, I. (Jan. 2004). “Receiving Other People’s Advice: Influence and Benefit”. English. In: *Organizational Behavior and Human Decision Processes* 93.1. WOS:000188504000001, pp. 1–13.
- Yaniv, Ilan and Shoham Choshen-Hillel (Dec. 2012). “Exploiting the Wisdom of Others to Make Better Decisions: Suspending Judgment Reduces Egocentrism and Increases Accuracy”. en. In: *Journal of Behavioral Decision Making* 25.5, pp. 427–434.
- Yaniv, Ilan and Eli Kleinberger (Nov. 2000). “Advice Taking in Decision Making: Egocentric Discounting and Reputation Formation”. en. In: *Organizational Behavior and Human Decision Processes* 83.2, pp. 260–281.
- Yaniv, Ilan and Maxim Milyavsky (May 2007). “Using Advice from Multiple Sources to Revise and Improve Judgments”. English. In: *Organizational Behavior and Human Decision Processes* 103.1. WOS:000246807900007, pp. 104–120.