How do Cognitive Processes regulate the Wisdom and Madness of Crowds?

A Registered Report

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SUMMARY

Understanding the conditions under which **human collectives act wisely or mad** has been a central focus of behavioral research. While there is a common understanding that **overreliance on social information** can result in **maladaptive herding behavior** (Frey & van de Rijt, 2020; Lee et al., 2015; Lorenz et al., 2011), there is **strong evidence** for **cognitive benefits** of **grouping** and interaction (Krause et al., 2002; Krause et al., 2010). We propose that **cognitive systems** (Sloman, 1996) involved in decision-making processes can partially explain preceding contradictory findings and test whether **individuals under** an **intuitive processing** mode (System 1) are **more sensitive** to **low quality** social **information**, which **decreases** their **accuracy** compared to individuals under an analytical processing mode (System 2). Results from a **pilot experiment** (n=80) **indicate** that **intuitive processing** leads to a **higher adaptation** toward **social information**, a **decrease in** individual **accuracy** and that these associations are **moderated by** social **information quality**. We will test our hypotheses with a large sample in a RCT using cognitive load and time pressure to elicit intuitive/analytical processing modes.

RESEARCH QUESTION

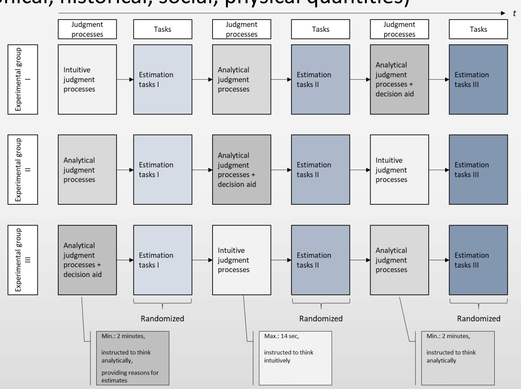
Are individuals under System 1 processing more sensitive to social information with a low/medium quality and less accurate compared to individuals under System 2 processing?

METHODS (pilot study)

Design:
Within-subjects design and Latin-square technique with incomplete counterbalancing
Sample size/ Observations :
80/ 1428
Experimental treatments:
Time pressure/ instruction-based
Stimuli:
22 estimation tasks (geographical, historical, social, physical quantities)

Estimation procedure:

1. Initial estimate (E_i)
2. Confidence in initial estimate
3. Social information (manipulated) T_1
4. Plausibility of social information
5. Revised estimate (E_r)
6. Confidence in revised estimate



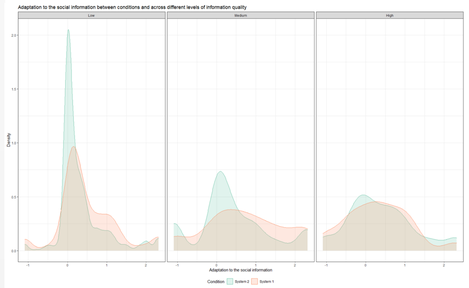
RESULTS (pilot study)

Table 1
Results of linear mixed models

	Social Adaptation			Change in Accuracy			Collective Accuracy		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	0.30	0.20 – 0.41	**<.001**	-0.11	-0.22 – -0.00	**.048**	-1.03	-1.22 – -0.84	**<.001**
Condition [System 1]	-0.03	-0.19 – 0.13	.713	0.16	-0.01 – 0.32	.059	-0.20	-0.52 – 0.12	.231
Information Quality [Low]	-0.03	-0.15 – 0.10	.683	-0.03	-0.16 – 0.10	.631	-0.11	-0.34 – 0.12	.360
Information Quality [Medium]	-0.09	-0.24 – 0.06	.252	-0.18	-0.34 – -0.03	**.022**	-0.19	-0.46 – 0.08	.162
Condition [System 1] * Information Quality [Low]	0.20	0.00 – 0.39	**.046**	-0.23	-0.43 – -0.03	**.026**	-0.29	-0.68 – 0.11	.155
Condition [System 1] * Information Quality [Medium]	0.47	0.24 – 0.70	**<.001**	-0.32	-0.56 – -0.09	**.007**	-0.13	-0.58 – 0.33	.582
Random Effects									
σ^2	0.58			0.61			0.28		
τ_{00}	0.01 $_{Subjects}$			<0.01 $_{Subjects}$			0.00 $_{Groups}$		
ICC	0.02			<0.01			0.00		
N	80 $_{Subjects}$			80 $_{Subjects}$			8 $_{Groups}$		
Observations	1428			1428			187		
Marginal R^2 /Conditional R^2	0.028/0.052			0.027/0.031			0.134/0.134		

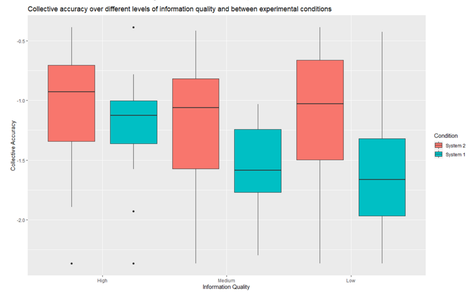
Note. High information quality and System 2 were used as reference values. Estimations made under treatments of Analytical I and II were summarized under System 2. Estimates were summarized for low (α = -2.5, -2, 2, 2.5), medium (α = −1, 1) and high information quality (α = −0.5, 0.5). Effect sizes were calculated by pairwise differences of regression estimates divided by SD of population. Estimations have been winsorized at the 5th and 95th percentile. 0 of the DV's represent keeping the initial estimate/ perfect accuracy.

Figure 1
Density plots of adaptation to social information



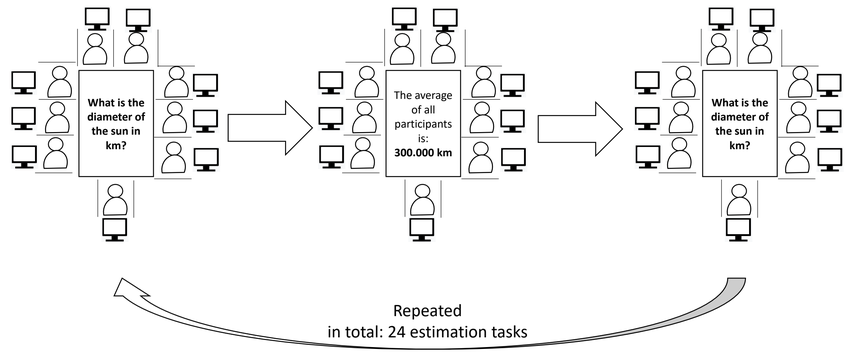
Note. Notes from Table 1 apply. Adaptation to social information has been calculated as in Jayles et al. (2020)

Figure 2
Collective accuracy between experimental conditions



Note. Notes from Table 1 apply. Collective estimates were calculated as the mean of absolute individual estimates of participants from one experimental session.

METHODS (main study) I



METHODS (main study) II

Treatments:
- 4 tasks **each** will be posed in a **low and high cognitive load** condition
- 4 tasks **each** will be posed in a **low and high time pressure** condition
- 8 tasks will be posed in **a control condition**

Order of estimation tasks and treatments will be randomized on the group-level

Cognitive Load	Time Pressure	Control
– Subtract three from a three-digit number vs. re-entering initial number every 15 seconds (indicated by a clock counting upwards) (Farias et al., 2017) – Enter (updated) number in a random 33% intervals.	– 14 vs. 120 seconds time for each step – Indicated by timer	– 120 seconds time for each step – No timer

Power analysis:
Simulation-based power analysis indicates needed sample size of a **360 participants** (40 groups of 9 subjects with 24 observations each) (Bonferroni-corrected α= .0029, β=.95)

IMPLICATIONS

- When social influence cannot be excluded in crowd decisions, preliminary results indicate that **crowds** might be **more accurate**, when they **engage in System 2** in comparison to System 1 processing
- A decision environment of crowds that **excludes/ reduces cognitive load/time pressure** of individuals might be **beneficial for crowd wisdom**
- Measures that might boost crowd wisdom in crowd decisions under social influence:
  - **„Forcing" individuals to take time/ giving individuals sufficient time** to make a decision/ judgment (Gervais, & Norenzayan, 2012)
  - Providing individuals with **decision aids** to elicit analytical thinking (Ashton, 1992)
  - Using **performance-based incentives** to elicit System 2 processing (Farrell, Goh, & White, 2014)

LITERATURE

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