# The ethics of genetic engineering: An empirical investigation

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## ABSTRACT

Recent advances in genetic testing and genome editing have revived ethical debates about its usage and legislation. However, laypeople's opinions on these questions have remained underexplored. We asked 124 Mturkers to express their opinions on 32 vignettes and ethical statements. Results indicate that more participants are against genetic engineering than in favour of it although opinions are widely spread. Moreover, they vary with the context of application as well as with participants' personal traits.

## MATERIALS & METHODS

- Participants: 124 MTurkers (81 males, mean age: 36)
- Questionnaire comprising 16 vignettes (fig. 1) and 16 ethical statements (fig. 2) about genetic testing and engineering, i.e. 32 items total
- Responses given on a 6-point Likert scale ranging from "Strongly agree" to "Strongly disagree" (fig. 3)
- Personal information collected about gender, political orientation, religiosity and personal experience with genetic testing and/or cancer

Jennifer is planning to conceive a child. She knows that severe hereditary diseases run in her family. **Jennifer is ethically required to perform a genetic test prior to conception.**

Fig 1: Example of a vignette

**Genetic tests are ethically impermissible even if a hereditary disease runs in a family.**

Fig 2: Example of an ethical statement

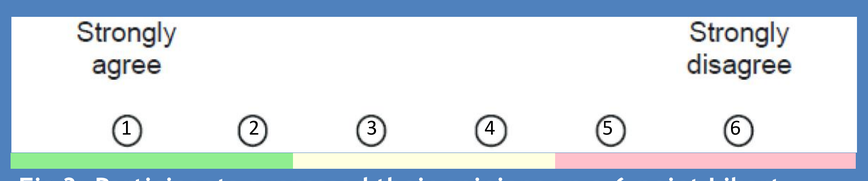


Fig 3: Participants expressed their opinions on a 6-point Likert scale (numbers and color coding not included in the survey)

## Data analysis:

- 45 participants excluded from analysis because they failed one of 8 attention checks
- Exploratory factor analysis using R, excluding 9 items

### Seven factors generated for 23 items:

Ethical permissibility of genetic testing and engineering

1 … for personalised medicine

2 … for reproductive medicine

3 … for other purposes (e.g., forensics) in humans

4 Permissibility of using those techniques on non-humans

5 Permissibility of nudging (e.g., financial incentives)

6 Moral responsibility for harms or personal traits

7 Social justice issues

## RESULTS

### 1. Participants are divided about genetic technologies

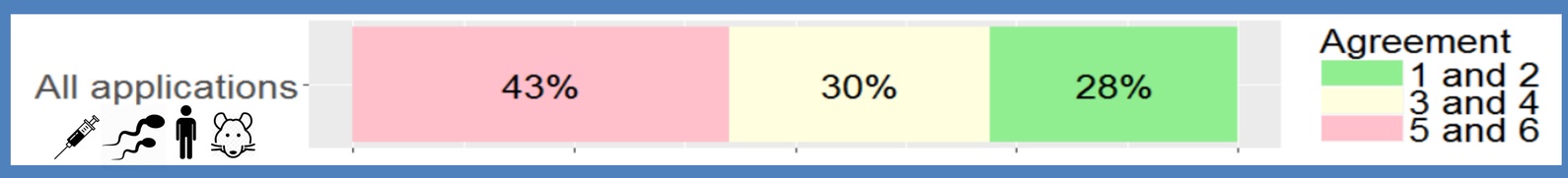


Fig. 4: Distribution of participants' opinions on all applications of genetic engineering. Data from various contexts of application were pooled for analysis. N = 79.

### 2. Approval ratings vary with context of application

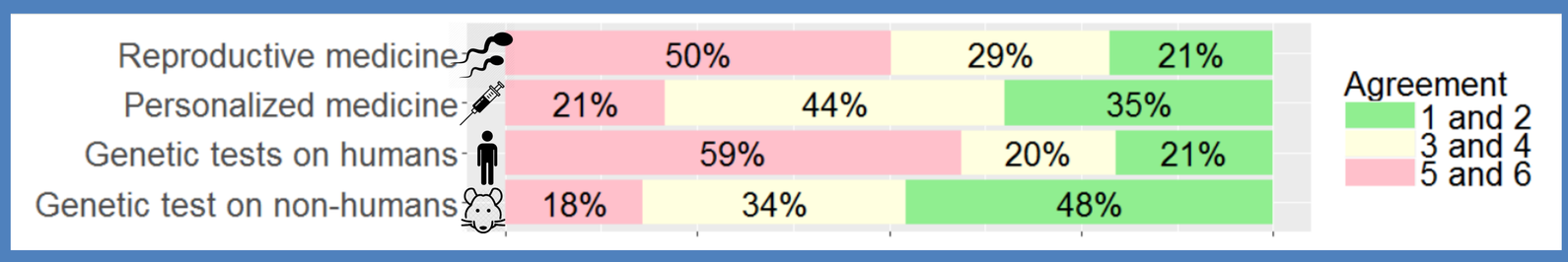


Fig. 5: Ratings of ethical permissibility vary with context of application. Data from above by context of application. N = 79. No of data points (from top to bottom): 120, 231, 219, 117

Findings on reproductive medicine and personalized medicine are in line with Gaskell et al. (*Nature Biotech* 2017)'s finding that participants prefer adult to prenatal therapy.

### 3. Ethical views correlate with individual traits

#### a. Gender affects opinions on genetic testing

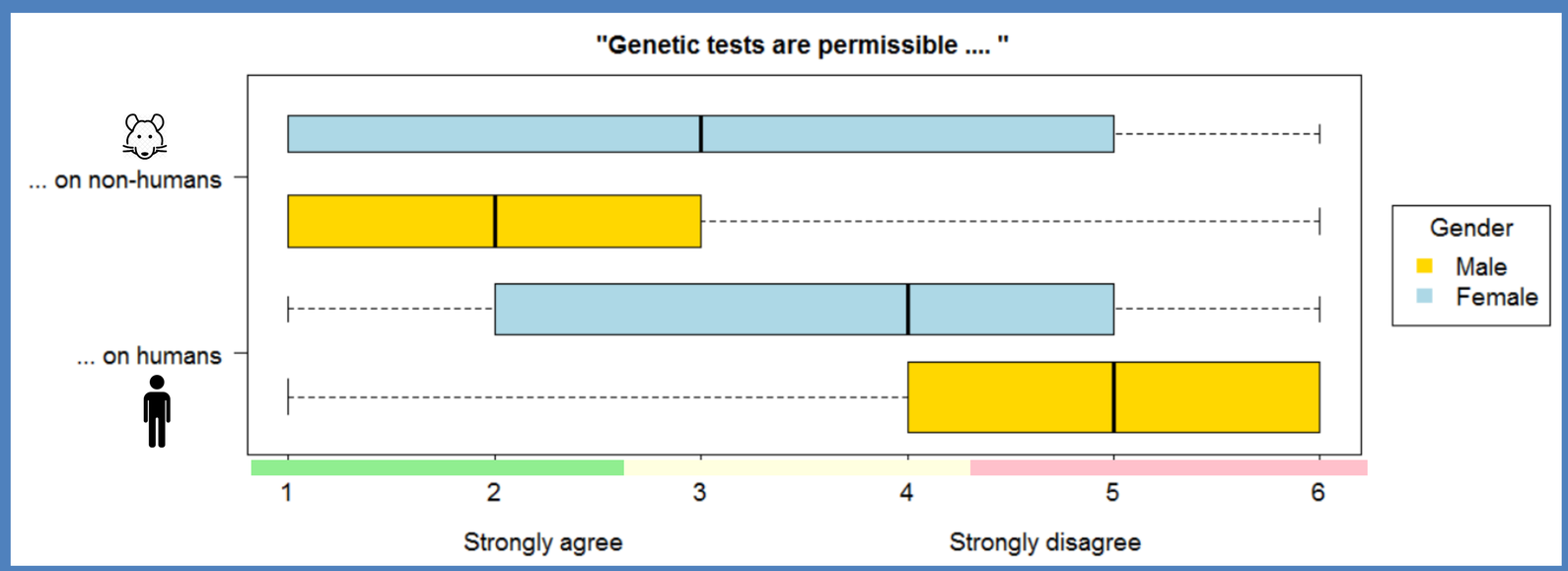


Fig. 6: Gender differences for views on genetic testing. Box plots show variations of ratings by gender (blue: male, yellow: female) and context of application (testing humans versus non-humans). Results of t-tests were statistically significant ($p<0.05$). N = 79. Mean ratings (from top): 3.30, 2.50, 3.96, 4.55. No of data points: 336.

#### b. Personal experience and religiosity affect opinions on reproductive medicine

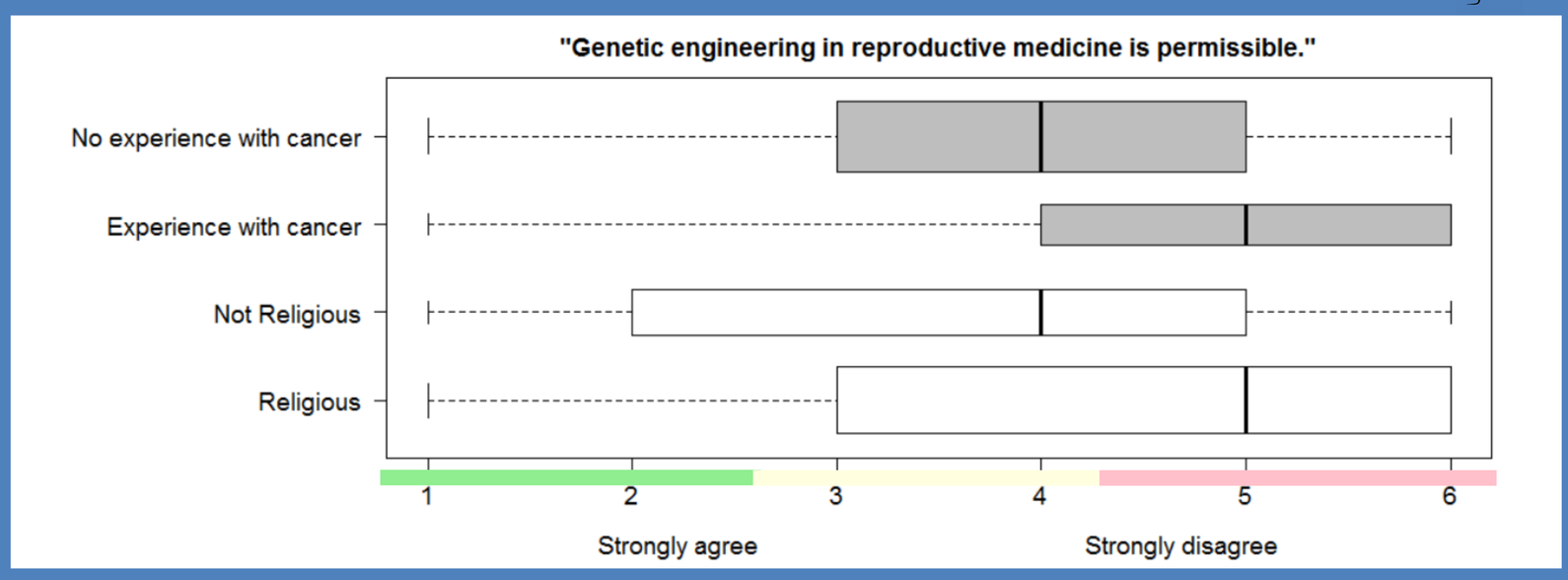


Fig. 7: Ratings of ethical permissibility vary with religiosity and personal experience with cancer. Statistically significant results ($p<0.05$) were obtained using t-tests. N = 79. Mean ratings (from top): 3.95, 4.68, 3.79, 4.29. No of data points: 120.

## CONCLUSION

- **People are divided about the ethics of genetic technologies**
- **Opinions vary greatly with context of application**
- **… as well as with people's individual properties**

## FUTURE RESEARCH

- **Investigate views on nudging, responsibility, and social justice**
- Find clusters of opinions
- Advice-taking effects: after the survey, participants read a text lauding/criticising genetic technologies before being asked whether they changed their mind on any of the 32 items. Does this advice-taking affect participants' (later) ratings?

## RESEARCH TEAM:

- Martin Haushofer, Benedikt Höltgen (LMU)
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