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## Aims

- Animal use in research, food contamination health scares or adverse events in clinical trials have often placed toxicology in the focus of both scientific and societal concern.
- We previously explored ethics in toxicology, especially conflict of interest (COI), transparency, reproducibility and funding of animal research (Walker and Roberts (2018) *Collaboration and competition: ethics in toxicology*. *Toxicol. Res.*, 576-585).
- Here, we investigate current attitudes of toxicologists to resourcing, collaboration, competition, research infrastructure and peer review.

## Methods

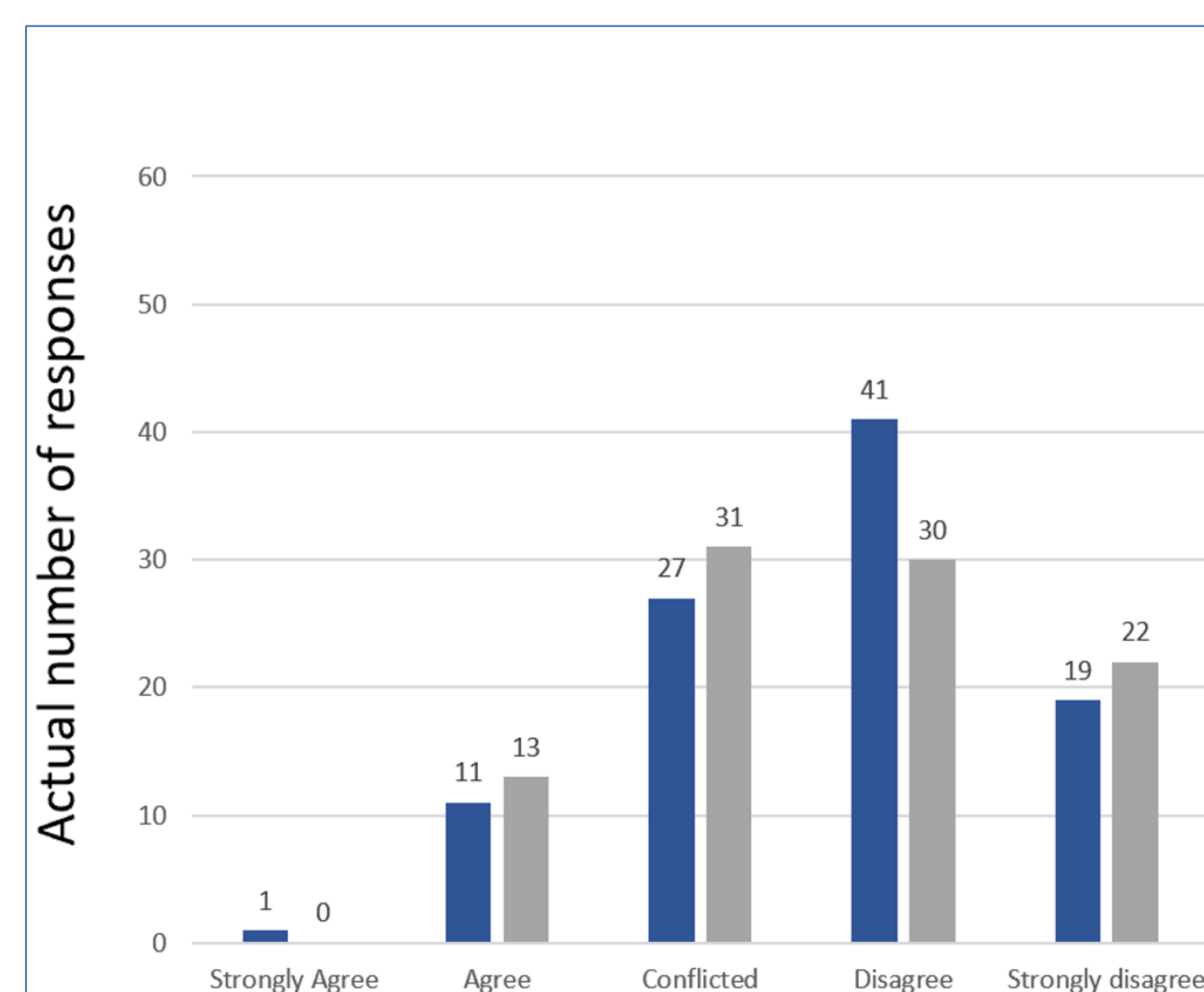
- A survey comprising 14 questions (Table 1) and a participants' information sheet were distributed to BTS members and meeting participants by the BTS Secretariat via a web link.
- Anonymised responses were collated into an excel spreadsheet. One hundred responses were received; thus data are presented as actual numbers of respondents but can also be quoted as percent response.
- Since this was an exploratory study, data are presented as a descriptive analysis of results.
- Only selected data are shown; full results are in Walker et al (2019) (*Tox Res*; submitted).

Table 1: Questions by number and response options

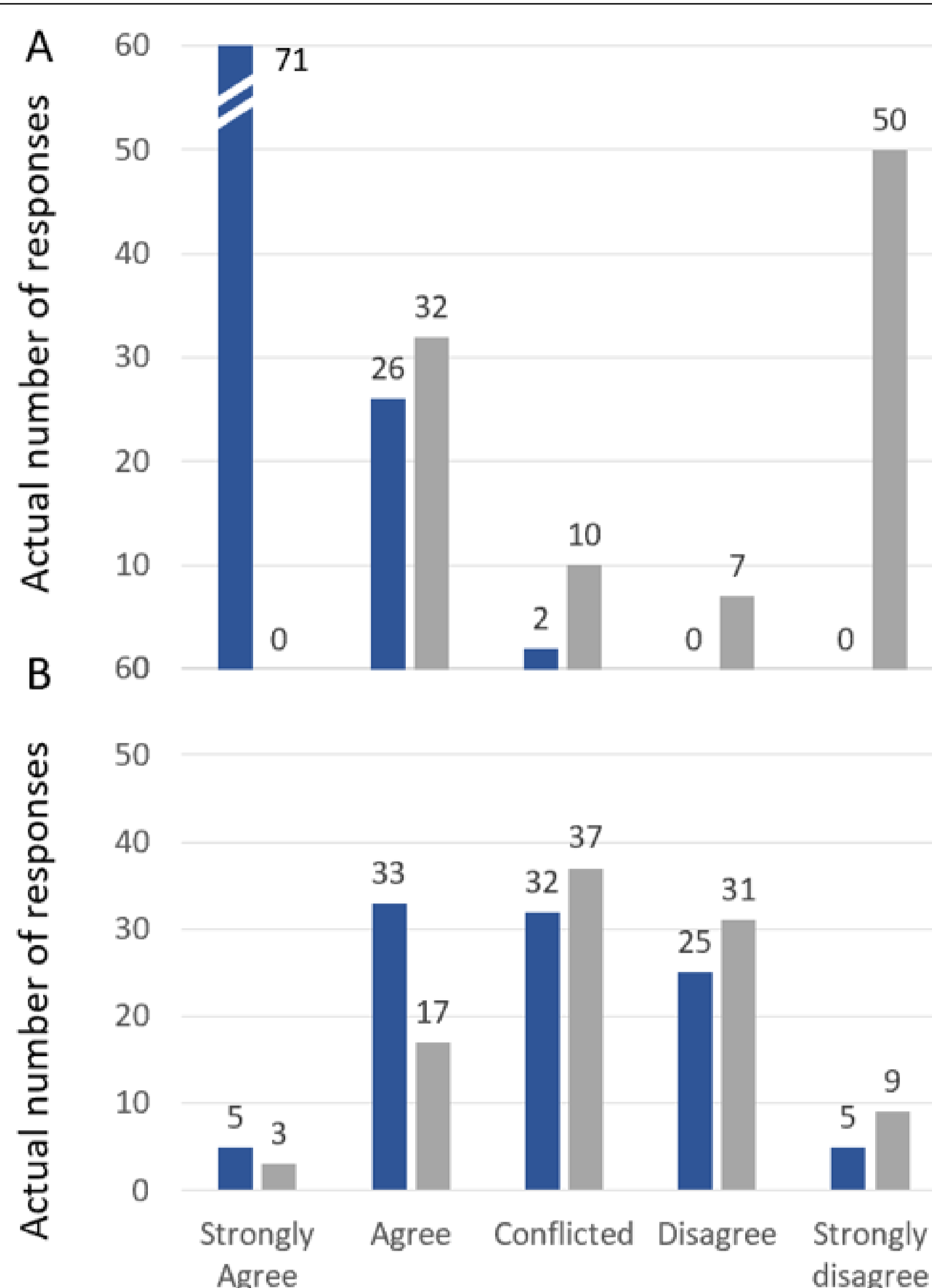
Number	Question	Response Options
1	I believe toxicology research is adequately resourced in the UK	Strongly Agree
2	When compared to other disciplines, I believe the research funding councils and other funding bodies provide equality of opportunity to facilitate toxicology research	Agree Conflicted Disagree Strongly Disagree
3	I believe collaboration to be important in driving toxicology research in the UK	
4	When compared to other disciplines, I believe collaboration to be especially important in driving toxicology research	
5	I believe competition to be important in driving toxicology research in the UK	
6	When compared to other disciplines, I believe competition to be especially important in driving toxicology research	
7	I believe there is a good infrastructure to support research between academia, industry and the regulatory authorities	
8	I believe making toxicology research data openly available with as few restrictions as possible in a timely and responsible manner would improve the impact and efficiency of toxicological research	
9	When reading research publications, I consider whether there is a conflict of interest when assessing the validity of research	
10	I believe the current system of peer review for research outputs is a fair and appropriate system	
11	When peer reviewing research publications, I consider whether there is a conflict of interest when assessing the validity of research	
12	I believe reviewers are often not sufficiently trained to adequately and fairly judge the merit, quality and impact of toxicology research	
13	I believe double-blind peer review, where both reviewer and author are anonymized, is a good idea	
14a	I believe open access publication, where articles are available free at source, is a good idea	
14b	Have you published research outputs using an open access route in the last two years?	Yes No
14c	If so, how was the cost for publication supported?	Institute or Employer Collaborator or industry sponsor Competitive research award Competitive research award (co-author) Funded personally Not applicable Other (free text)

## Results and discussion

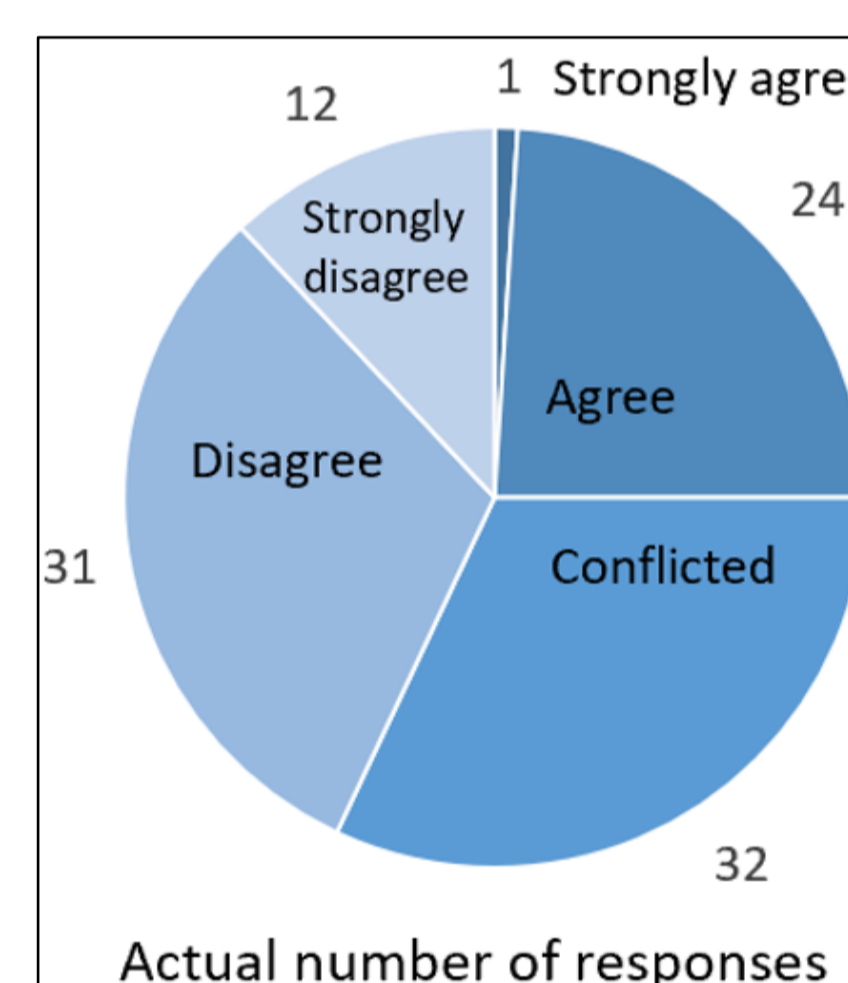
- Many participants (60%) disagreed that toxicology research is adequately funded in the UK; only 12% agreed with this statement (Figure 1). A similar proportion of participants (53%) disagreed that funding councils give equal opportunity to toxicology and 31% were conflicted (Figure 1).
- Almost 100% of respondents agreed that collaboration is important in driving toxicology but only 32% agreed that collaboration is uniquely important in toxicology (Fig 2A).
- In contrast, only 38% agreed that competition is important in toxicology; 30% disagreed with this statement (Figure 2B). Participants held similar views on competition in toxicology versus other types of research.
- Many respondents were conflicted on the role of competition; free text comments highlighted that some competition drives quality but can be counterproductive when competing for limited resources (data not shown).
- Few participants agreed that there is a good infrastructure to support research between academia, industry and the regulatory authorities (Figure 3). Those who were conflicted offered free text answers (Table 2) focusing on room for improvement, role of the individual and real or perceived COI.
- Most participants favoured making toxicology research data openly available (86%) and favoured open access publication (89%) (Figure 4) although free text comments indicated reservations about the cost of open access (data not shown).
- Many (60%) thought the current system of peer review is fair but 65% also supported the idea of double-blind peer review (where both reviewer and author are anonymized; data not shown). Free text comments both for and against double blind peer review focused on anonymity, process and value (Table 3).



**Fig. 1. Views on Resourcing in Toxicology.** Responses to two questions are shown: "I believe toxicology research is adequately resourced in the UK" (blue) and "When compared to other disciplines, I believe the research funding councils and other funding bodies provide equality of opportunity to facilitate toxicology research" (grey).



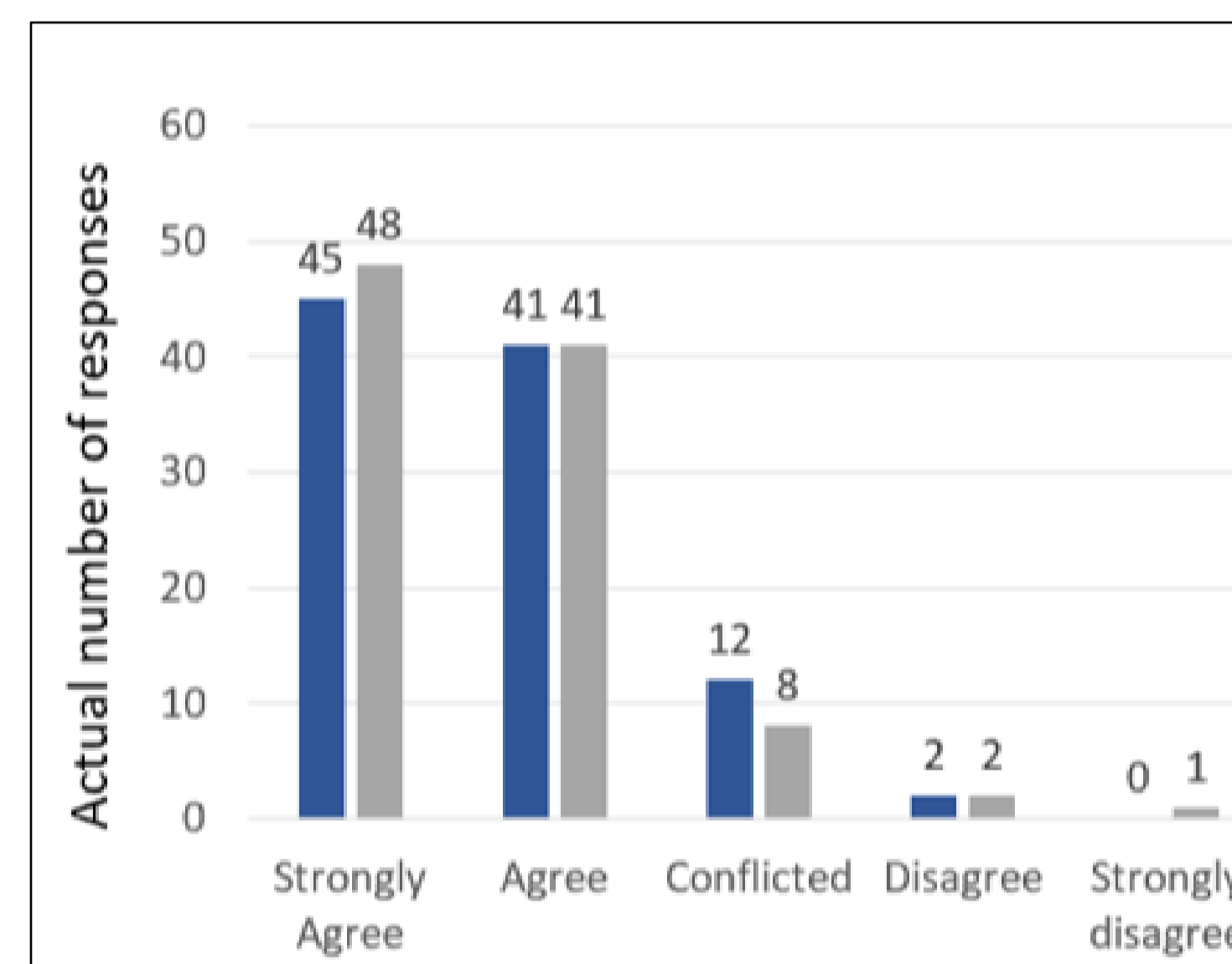
**Fig. 2. Views on Collaboration and Competition in Toxicology.** (A) Responses to two questions are shown: "I believe collaboration to be important in driving toxicology research in the UK" (blue) and "When compared to other disciplines, I believe collaboration to be especially important in driving toxicology research" (grey). (B) Responses to two questions are shown: "I believe competition to be important in driving toxicology research in the UK" (blue) and "When compared to other disciplines, I believe competition to be especially important in driving toxicology research" (grey).



**Fig. 3. Views on Research Support Infrastructure.** Responses to one question are shown "I believe there is a good infrastructure to support research between academia, industry and the regulatory authorities".

Table 2. Free text conflicted responses to question 7 (research infrastructure).

Overall point	Example answers
Mixed - room for improvement	The collaboration is present at the BTS congress and other meetings. Otherwise interactions can be limited especially with regulatory agencies. There are good industry/academic links, but we should harness these links more broadly rather than company by company There could be more done to support this. In some instances, I agree, however more collaboration between more academic departments and institutes would be welcome instead of just a few working with industry. Yes and No - my issue is that on the whole regulatory authorities do a good job, but they are often difficult to deal with and can be fairly unhelpful. It should be more a collaborative approach.
It's about individuals	I think it depends on the individual authorities/ institutions I have experience of when the different areas have worked well together. But this has been down to the good will of the individuals concerned, rather than anything that stems from government funded actions. Where it works well it's about networks & personal relationships rather than infrastructure - depends on individuals' commitment to making something happen ...
Real or perceived COI	Mixed feelings here. On the one hand academic institutions are forced to cooperate with other partners due to declining funding from government bodies. On the other hand society is suspicious to this cooperation. Moreover, many regulatory authorities want to be "independent" and not very keen on cooperation. For some collaborations this exists but the perception of the conflicting interests of these 3 organizations often prevents effective collaboration.



**Fig. 4. Views on Open Access.** Responses to two questions are shown "I believe making toxicology research data openly available with as few restrictions as possible in a timely and responsible manner would improve the impact and efficiency of toxicological research" (blue) and "I believe open access publication, where articles are available free at source, is a good idea" (grey).

Table 3. Free text responses to question 12 (double blind peer review).

	In favour	Against
Anonymity	Gives more opportunity to unknown and up-and-coming groups	It's good to know the group's history and reputation It doesn't take much to work out who the authors are and where they are from I am happy to be identified as a reviewer and would prefer that rather than blinding the authors
Process	Not sure how this would work	It's too complex Already too time consuming - this would make it worse Is this even feasible?
Value	It seems fairer Good to decide purely based on what is presented	I can't see how this would help Is there a problem to fix?

## Conclusions

- Many believe collaboration is important in toxicology.
- There were mixed views on the role of competition.
- Many support the current system of peer review but are open to new approaches.
- Many believe that the need for experienced toxicologists has increased at a time when training and investment in the discipline has declined.
- However, not all respondents held that view with some noting that toxicology both as a research and as an applied discipline is strong within the UK scientific community.
- Free text comments specifically highlighted the positive role of the BTS in facilitating training, education and collaboration (data not shown).

## Acknowledgements

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