# Logical expertise as a cause of error: A reply to Boolos

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What is one to make of a paper on syllogistic inference whose author does not distinguish between "All A are B" and "All the A are B"? Boolos (1984) writes that the inference:

> None of the archers are boxers
> All the boxers are clerks
> Therefore, some of the clerks are not archers

is not valid, and proposes that its second premise should be analyzed as:

$$\forall x(Bx \rightarrow Cx).$$

He has overlooked two points. First, in these premises, as in all the problems we gave our subjects, each assertion contains a definite article, e.g. "All the boxers are clerks". Such definite descriptions establish or presuppose the existence of members of the corresponding sets. Second, we explicitly instructed our subjects that each problem concerned three sets of individuals gathered together in a room. We therefore doubly ensured that there was no doubt about the existence of individuals in all three sets.

It follows that Boolos's analysis of "All the boxers are clerks" is wrong since it is consistent with the non-existence of boxers. It also follows that the inference above is, as we claimed, entirely valid.

Boolos is neither the first nor, we imagine, the last to err in this way, e.g. Kyburg (1983, p. 266) anticipates him. Indeed, logicians from California to East Anglia have made the same mistake so often that the phenomenon has become worthy of psychological investigation in its own right. We believe that the following conditions are necessary to give rise to it:

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(1)    Expertise in the predicate calculus and a knowledge of the debate over universals and existence.

(2)    A belief that psychologists know nothing of these matters.

Two further conditions are likely to encourage the error:

(3)    Irritation with our thesis that ordinary individuals make valid deductions by manipulating mental models rather than by following formal rules of inference.

(4)    A legitimate opportunity to point out that universal quantification in the predicate calculus does not imply existence—as provided by our discussion of Guyote and Sternberg's (1981) materials.

As a result of these and perhaps other more idiosyncratic factors, theorists fail to read our paper in its entirety; or, if they do read it, they do not pay complete attention to it; or, if they do pay complete attention to it, they do not remember all of it. Boolos appears to fall into one of these categories, since ne makes no reference either to our explicit allusion to Aristotle's views on universals and existence (in our discussion of Newell's theory) or to the following remarks (in Section 3): "The presence of the definite article in this assertion ['All of the X are Y'] implies that X's definitely exist. An assertion of the form, 'All X are Y', is often taken to have no such existential implication, e.g. 'All deserters will be shot' can be true even if there are no deserters." We even went on to discuss how such assertions are mentally represented.

The failure to distinguish between "All A are B" and "All the A are B" may arise in perception or memory (or both). In any case, however, it appears to be a phenomenon in which logical expertise, far from being a defence against error, is necessary for its occurrence.

# References

Boolos, G. (1984) On 'syllogistic inference'. *Cog.*, *17*, 181–182, this issue.

Guyote, M.J. and Sternberg, R.J. (1981) A transitive-chain theory of syllogistic reasoning. *Cog. Psychol.*, *13*, 461–525

Kyburg, H.E., Jr. (1983) Author's reponse: The role of logic in reason, inference, and decision. *Behav. Br. Sci.*, *6*, 263–273.