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Subjective belief distributions and the characterization of economic literacy☆

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ABSTRACT

We characterize the literacy of an individual in a domain by their elicited subjective belief distribution over the possible responses to a question posed in that domain. By eliciting the distribution, rather than just the answers to true/false or multiple choice questions, we can directly measure the confidence that an individual has about their knowledge of some fact. We consider literacy across several financial and economic domains. We find considerable demographic heterogeneity in the degree of literacy. We also measure the degree of consistency within a sample about their knowledge, even when that knowledge is imperfect.

When we say that someone is literate we mean more than that they can just "read and write." The term more generally indicates someone who is educated, whether by formal or informal means, and able to comprehend topics through words.[1] Characterizing and measuring the literacy of an individual requires then that we have some way of assessing *how* knowledgeable the person is about certain topics. There are some topics about which one can have "crisp" knowledge, in the sense of Boolean truth values. However, there are many domains of knowledge that one naturally expects varying levels of precision. We characterize literacy in terms of the subjective beliefs that someone has over possible responses to some question. By eliciting the subjective belief *distribution*, rather than just the answers to true/false or multiple choice questions, we can directly measure the confidence that an individual has about their knowledge of some fact.

Following Savage (1971, 1972), we *define* subjective beliefs by the choices that individuals make when facing bets whose outcomes depend on those beliefs. The measurement of the literacy that someone has in a specific domain entails the elicitation of their subjective beliefs. For that task we conduct an experiment using proper scoring rules, which are simply structured bets offered to the individual by an observer (the experimenter). All of the elicited beliefs were incentivized and incentive-compatible, so that the subjects were making real choices with real economic consequences.

Our approach is to elicit the entire subjective belief *distribution* that an individual has, to ascertain how precise their knowledge is in response to some question. This extends and generalizes the prevailing approach to measuring literacy, which considers responses to (hypothetical) multiple choice questions (e.g., Lusardi and Mitchell, 2007, 2008, 2012; §3). For a specific question or domain, we are able to say "how literate" the person is, rather than just say that they are or are not literate. Of course, by asking a series of questions one can ascertain the fraction of correct answers for an individual with the traditional approach, but that requires one to pool responses over different questions which may span different knowledge domains.

The domains of interest to us are financial and economic knowledge. We consider a mixture of questions in which the correct answer involves the application of logical and grammatical principles, and questions in which the correct answer involves some specific fact. This reflects a trend in the measurement of literacy toward the ability to draw logical or grammatical conclusions from information

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[1] The Oxford English Dictionary (second edition) defines the adjective "literate" as someone who is "acquainted with letters or literature; educated, instructed, learned." Remund (2010) offers a balanced account of the many definitions of literacy found in the academic and policy literature. Our focus on financial knowledge corresponds to the first of his categories of conceptual definitions of literacy (p. 279).

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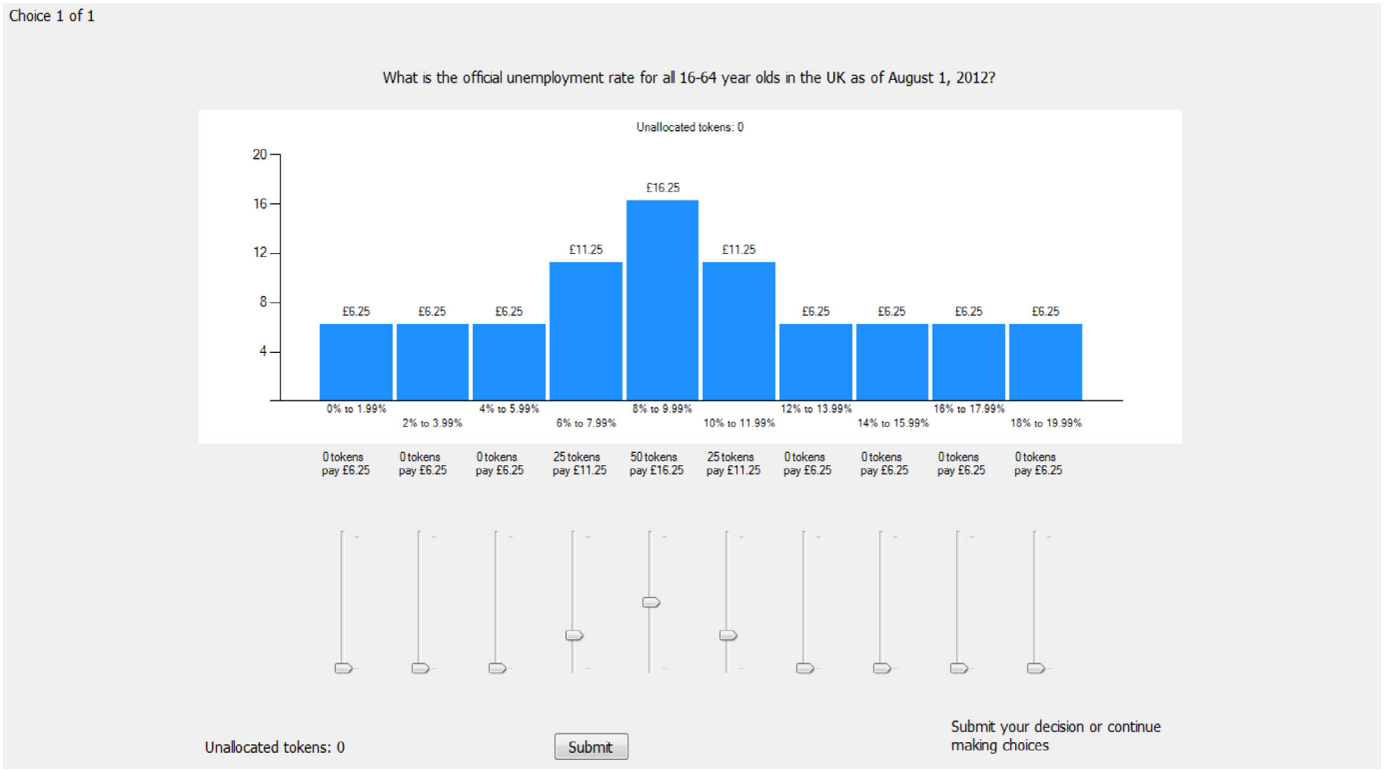

Fig. 1. Belief elicitation interface.

presented in the question itself, and to also consider awareness of facts that are of importance for the functioning of the individual. We apply and extend two questions on financial planning and literacy by Lusardi and Mitchell (2007, 2008) that have been used in the 2004 Health and Retirement Survey (HRS). These questions measure the ability to understand and apply simple economic concepts that are important in economic planning for the future such as compounding of interest and inflation. We also ask individuals two questions on longevity, which is relevant for retirement planning. These questions have been used by Bateman et al. (2012) and in the HRS since 1992. The four questions are documented and discussed further in Section 1.

A byproduct of our characterization is that we can also say something about the degree of common knowledge that a sample of individuals have about some proposition. Quite apart from whether or not a given individual knows the true answer with some precision, we often want to know if a group of individuals have the same degree of knowledge. In effect, we are able to operationalize several interpretations of what it means to have heterogeneous beliefs.

Literacy is an important characteristic of economic behavior in its own right. It is also something that behavioral and experimental economists should be interested in, since it goes to the heart of whether someone has understood some task or not. If behavioral economics is concerned with decisions that are commonly characterized as "mistakes" relative to some standard model or normative criterion, then it is critical to know if the decision was a "correct" decision for a misunderstood task, or an "incorrect" decision for an understood task. In psychology this is the area of task representation, and literacy is one input into a subject arriving at their representation. Similarly, when experimental economists claim that a subject has responded to a task with certain properties, such as incentive-compatibility, they need to know whether the subject has indeed understood the task and its properties: again, literacy is one input into this process.[2]

Our results show a considerable variation in literacy levels over the financial and economic domains we consider here and across observable demographic characteristics. In particular, older subjects are more literate than younger subjects in the interest compounding domain, and women exhibit higher literacy than men in the inflation domain. We also find that Whites are more literate than non-Whites regarding the expected remaining lifetime of men, and older subjects are more literate than younger subjects regarding the expected remaining lifetime for women.

In Section 1 we describe the experimental task that we developed and employed with a sample of 120 subjects. We review in detail the properties of the subjective belief elicitation procedure in Section 2 and present results on the degree of literacy of our subjects in Section 3. In Section 4 we consider the consistency of knowledge across subjects, and Section 5 concludes.

1. Procedures

1.1. Literacy

We consider literacy in terms of four specific questions asked of each subject in an experiment. In each case there is a correct answer, and responses were elicited over a continuous range of possible answers presented in terms of 10 intervals or "bins." A computer interface was used to present the belief elicitation tasks to subjects and record their choices, allowing them to allocate tokens in accordance with their subjective beliefs. Fig. 1 presents the interface.[3] The interface implements the Quadratic Scoring Rule discussed in Section 2. Subjects could move the sliders at the bottom of the screen to re-allocate the 100 tokens as they wished, ending up with some distribution. The instructions explained that they could earn up to

[2] An important example in experimental economics is the Becker, DeGroot and Marschak (1964) procedure for eliciting certainty-equivalents of lotteries. There remains a considerable controversy about whether subjects understand the incentive-compatibility of this procedure (Cason and Plott, 2014).

[3] The instructions are reproduced in full in Appendix A. The interface was initialized with 10 tokens allocated to each bin.