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# Experimental methods: Measuring effort in economics experiments

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ABSTRACT

The study of effort provision in a controlled setting is a key research area in experimental economics. There are two major methodological paradigms in this literature: stated effort and real effort. In the stated-effort paradigm the researcher uses an "effort function" that maps choices to outcomes. In the real-effort paradigm, participants work on a task, and outcomes depend on their performance. The advantage of the stated-effort design is the control the researcher has over the cost of effort, which is particularly useful when testing theory. The advantage of the real-effort design is that it may be a better match to the field environment, particularly with respect to psychological aspects that affect behavior. An open question in the literature is the degree to which the results obtained by the two paradigms differ, and if they do, why. We present a review of methods used and discuss the results obtained from using these different approaches, and issues to consider when choosing and implementing a task.



## 1. Introduction

Understanding when and how individuals exert effort is critical to many questions in economics. While a large literature in experimental economics studies effort provision, different approaches have been used to operationalize it experimentally. Experimental economists have primarily utilized two methodological paradigms: stated effort and real effort. There is limited theoretical and/or experimental evidence to guide researchers in deciding which task to use. Furthermore, there are many real-effort tasks and ways to implement them.

With stated effort, the choice of "effort" involves clear numerical costs and benefits. In a typical implementation, participants are presented with a menu that displays a discrete selection of effort levels (e.g., from 1 to 10) and a corresponding list of costs. These costs often influence the profits of another subject, as in a gift-exchange situation (Fehr et al., 1993, 1997; Charness, 2004), or in a tournament involving effort (Müller and Schotter, 2010; Bull et al., 1987). The advantage of the stated-effort approach is that there is no uncertainty regarding an individual's cost of effort. A potential drawback of the

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method is that simply choosing a number may not capture the field environment and the psychological forces involved in putting forth actual effort.

Real-effort tasks measure the behavior of participants given specific observable tasks, such as solving mazes (Gneezy et al., 2003), solving anagrams (Charness and Villeval, 2009), adding series of two-digit numbers (Niederle and Vesterlund 2007), counting the number of zeros in a large grid (Abeler et al., 2011), transcribing meaningless "greek" letters (Augenblick et al., 2015), and cracking walnuts (Fahr and Irlenbusch, 2000). The effort could be physical, as in folding pieces of paper and stuffing envelopes, cognitive, as in solving a series of math equations, or creative, as in writing stories or packing quarters. The advantage of the real-effort method is that it is closer to the psychology of working. For example, the cost of effort might vary over time: solving mazes might be fun initially, but might gradually become less motivating. A potential drawback is that the researcher does not know the cost of effort (and perhaps not even the sign of the effort cost; Gross et al., 2015) for participants, so that testing theories is more challenging.

A key purpose for conducting a laboratory experiment is to use the advantages of a controlled environment to learn about an economically-interesting phenomenon. We identify several dimensions that are important when deciding about effort measurement, such as the timing of the effort decision, the existence of goal-oriented decision-making, and the particulars of decisions over effort and money. Our aim is to help organize the considerations involved in both picking the methodology best suited to the research question at hand and understanding the key limitations of that methodology.

## 2. Stated-effort experiments

Testing specific models is a central focus of many effort experiments, and this typically requires experimental control over the relevant components of the theory. One needs a clear mapping from the cost of effort to the resulting productivity. Models may rely upon specific characterizations of the properties of the cost of effort function. For example, the cost of function it may be linear such that each unit of effort has the same associated cost, or it could be convex, such that the cost of each additional unit of effort is increasing. Such properties may be important to the predictions of specific models.

Smith (1976) introduced and argued for induced value, which forms the logical basis for stated effort. Although many economic experiments make use of the induced-value paradigm, we focus here on papers that explicitly used it (at least in motivation) to study effort. The gift-exchange game using induced values and stated effort was first tested in Fehr et al. (1993) and has led to important insights and has had great impact on our understanding of labor relations. In a simplified version of this game, a firm chooses a wage between 0 and 100, and the firm's earnings are determined by (100-w)*e. The worker's earning is the wage less the cost of the effort level chosen. This is the cost-of-effort schedule:

| $e$ | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| $c(e)$ | 0 | 1 | 2 | 4 | 6 | 8 | 10 | 12 | 15 | 18 |

This method is useful when considering social preferences, since the relationship between the firm's payoff and the worker's payoff is completely known to the worker and the "sacrifice" of freely-chosen higher effort provides clear benefits.

Stated effort is also useful for testing models in tournament settings. For example, Müller and Schotter (2010) consider the prize structure in contests, testing the Moldovanu and Sela (2001) model that shows the optimal structure depends on whether the cost-of-effort function is convex or not. The experimental results show that low-ability workers tend to "drop out" and provide little or no effort (this is not part of the equilibrium in the theoretical model), while high-ability workers provide excessive levels of effort, so that there is a bifurcation of effort. Nevertheless, the firm overall receives the expected amount of effort. The cost of effort was implemented as either a linear function or a quadratic function of the "decision number" (effort). The $2 \times 2$ experimental design also varied whether one prize or two prizes were awarded for the group of four participants. It seems clear that one would be unable to test this model with real effort, since the cost of effort would be unknown for each individual.

We list below a number of prominent papers that use a stated-effort methodology, by their research areas, main findings, and significance. Several previous and more extensive literature reviews examined experiments that used stated effort in specific fields such as labor (Charness and Kuhn, 2011) and coordination (Devetag and Ortmann, 2007). A number of experimental public-goods games (reviewed in Chaudhuri, 2011), trust games (reviewed in Johnson and Mislin, 2011), and principal-agent games (e.g., Charness and Dufwenberg, 2006; Brandts et al., 2016) also use the logic of stated effort, but are not explicitly about effort. Our list is neither meant to be exhaustive or an attempt to rank the most important papers, but rather to highlight how stated-effort has been used productively in a variety of research areas. For more detail, we refer people to the literature reviews mentioned above.

## 3. Real-effort experiments

Researchers have used different real-effort tasks in laboratory and extra-laboratory (lab-in-the-field) settings. In Table 2, we present a partial list of real-effort tasks used in these types of settings; we then qualitatively evaluate these based on