Acta Psychologica 148 (2014) 63–73

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/ locate/actpsy

How fast can you (possibly) do it, or how long will it (certainly) take? Communicating uncertain estimates of performance time

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ARTICLE INFO

Article history:
Received 12 September 2013
Received in revised form 5 December 2013
Accepted 5 January 2014
Available online 31 January 2014

PsycINFO classification:
2340 Cognitive Processes
2720 Linguistics & Language & Speech

Keywords:
Time on task
Effort estimates
Framing
Verbal probability
Communication of uncertainty

ABSTRACT

Recent research on verbal probability statements has revealed that some expressions (e.g., *possible*) are especially appropriate for describing outcomes in the high end of a distribution, whereas other expressions (e.g., *certain*) are more appropriate for describing low-end values. However, some dimensions appear to be reversible, with higher achievements sometimes associated with high and sometimes with low values, depending on frame. We report three experiments where this "reframing effect" is studied in communications of estimated performance time, both from a speaker's and from a listener's perspective. We hypothesize that statements describing tasks as "taking time" suggest a *duration frame*, and find accordingly that statements about how many hours that *possibly* will be spent on a task, or the time a task *possibly* takes, lead to high time estimates. Statements focusing on the actor's role suggest, in contrast, a *speed frame*, thus statements about what the actor can *possibly* do lead to low time estimates. Estimates of the time a task *certainly* takes or when it is *certainly* done follow the opposite pattern. The results are in line with approaches that see production and comprehension of language as a dynamical and context-driven process.

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1. Introduction

How long will it take you to drive to work tomorrow? Is it possible to finish this assignment in 5 h? People are frequently engaged in predictions of performance time for various tasks, both in their daily lives and in more professional settings. Performance time predictions (also referred to as "effort estimates" or estimates of "time on task") have received much attention from researchers both in psychology and project management (see Halkjelsvik & Jørgensen, 2012, for a recent review), with the main focus on inaccurate and overoptimistic performance time predictions and how they can be improved.

We focus, in contrast, on how performance time predictions are communicated. More specifically we ask whether and how people's predictions are influenced by the way questions are formulated, or framed, and how people perceive and interpret performance time predictions made by others. Does it matter whether people are asked to give time estimates emphasizing the *duration* of task T (the time T can take), or alternatively the *speed* with which T can be performed (the time T can be done in)? Understanding how people communicate time estimates is important, since subjective performance time predictions, often communicated verbally, are used as inputs for decision making both in business, public affairs, and in daily life.

1.1. Predictions of performance time

Performance time predictions are usually produced in response to a question. Traditionally, the question has been "how long will it take to do task T" (Roy, Christenfeld, & McKenzie, 2005), and the answer is given in terms of time units (minutes, hours, days, weeks, etc.) needed to accomplish T. In the case of uncertain estimates, one might ask about the *most likely* number of hours, the *minimum* number of hours ("best case"-estimate) and/or the *maximum* number of hours ("worst case"-estimate) (Jørgensen et al., 2004; Lichtenberg, 2000). There is further an extensive literature on completion time estimates ("when/which date will you finish task T"), typically revealing over-optimistic predictions, known as the "planning fallacy" (Buehler, Griffin, & Peetz, 2010). Recent studies have also compared time on task predictions with amounts of work believed to be completed in a given amount of time, i.e., "how many pages will you be able to read in one hour" (Halkjelsvik, Jørgensen, & Teigen, 2011; Jørgensen & Halkjelsvik, 2010). Finally, to come to grips with the uncertainty inherent in large scale projects, project managers often solicit confidence intervals, i.e., estimated ranges within which actual performance time is supposed to fall with a stated probability. For instance, an engineer might respond that he is 90% (or even 98%) certain that a task will take between 300 and 600 h

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http://dx.doi.org/10.1016/j.actpsy.2014.01.005

(Connolly & Dean, 1997). Alternatively, the uncertainty of an estimate might be communicated more informally through verbal probability expressions ("it is *very unlikely* that the task will take more than 600 hours"), a topic that will be discussed shortly.

The question one asks about performance time will undoubtedly influence the answer one is given. For instance, it seems obvious that asking for a "best case"-estimate should lead to a lower number of hours than asking for a "most likely"-estimate (but in practice, this is not always the case; Jørgensen, 2011). Similarly, how a speaker chooses to communicate a time estimate could influence how a listener perceives the estimate. Consider for example the following two informal statements about the duration of a task: (a) "It is possible that the task can be done in 5 hours", and (b) "It is possible that the task will take 5 hours". Although both statements indicate 5 h to be a possible task duration and accordingly appear to be equivalent, we will show that the statements point in different directions, with statement (a) suggesting a best case-estimate and (b) being more similar to a worst case-estimate. We argue in this paper that this is partly a function of the way the statement is framed, and partly due to pragmatic implications of the term "possible".

1.2. Verbal expressions of uncertainty

When people encounter events where the outcome is uncertain, they often use verbal probability expressions to communicate their judgments of uncertainty to others. A football fan might state that it is *quite probable* that Bayern München will win against Lyon, and a weather forecaster might say that it is *possible*, but *not very likely* that it will rain tomorrow. Similarly, verbal probability expressions can be used to qualify performance time predictions, as demonstrated by the use of point estimates of the *most likely* number of hours needed for a task.

Psychological research on verbal probabilities has traditionally used a "translation" approach, where people have been asked to describe numerical probabilities (or visual displays of probabilities) in words (e.g., Budescu & Wallsten, 1990; Budescu, Weinberg, & Wallsten, 1988), or even more common, to suggest numerical probabilities corresponding to a set of verbal probability expressions (Brun & Teigen, 1988; Clarke, Ruffin, Hill, & Beamen, 1992). The main finding from such studies is that even though there is some agreement about different expressions at the group level, there is large variability in the interpretation of verbal probability expressions between different individuals, indicating that the probabilistic meaning of such expressions is quite vague. This vagueness can in turn be mapped by picturing the meaning of each term as a distribution rather than a point estimate on the [0,1] probability scale (Budescu & Wallsten, 1995; Dhami & Wallsten, 2005).

However, translation studies do not capture the whole truth about verbal probabilities. Another important aspect is that different verbal probability expressions can have opposite *directionality*, pointing either towards the probability of the occurrence or towards the non-occurrence of an event (Teigen & Brun, 1995). So, if engineer A says that it is *very probable* and engineer B says that it is *not quite certain* that the task will be finished in 10 h, A is focusing on the probability that the task is finished after 10 h, while B is focusing on the complementary outcome, namely that the task might *not* be finished after 10 h. The directionality of verbal probability expressions suggests different foci of attention, and can thereby influence decision making and reasoning (Teigen & Brun, 1999).

A recent set of studies has made use of an alternative approach by asking participants which *outcomes* different verbal probability expressions describe, rather than which probabilities they suggest (Teigen, Juanchich, & Filkuková, 2014). In this alternative "Which Outcome" (WO) approach, participants are provided with a complete set of outcomes; for instance, a bar graph describing the battery life for a brand of laptop batteries is shown, with 10% of the batteries lasting 1.5 h, 20% lasting 2 h, 40% lasting 2.5 h, 25% lasting 3 h and 5% lasting 3.5 h. The participants are then asked to complete statements containing verbal probability expressions, such as "It is *possible* that the battery will last for _____ hours".

Several verbal probability expressions have been investigated by the WO-approach, giving new insights into the way these expressions are used. For instance, the expressions *unlikely* and *improbable* were found to be used about outcomes that has never occurred (Teigen, Juanchich, & Riege, 2013). This zero (or close to zero) probability differs sharply from the values obtained by the translation approach, where participants commonly suggest probabilities in the 10–30% range when asked to convert *improbable* into numbers. *Possible*, which is in other studies interpreted as indicating an event that has around 50% probability of occurring, was mainly chosen to describe outcomes from the top of the distribution ("It is possible that the battery will last for 3.5 hours"), despite the fact that top outcomes occur quite rarely. *Certain*, which is usually translated into numerical probabilities close to 100%, turned out to be associated with outcomes from the low end of the distribution ("It is certain that the battery will last for 1.5 hours") (Juanchich, Teigen, & Gourdon, 2013; Teigen et al., 2014). This apparently paradoxical usage of *certain* becomes less strange in view of the fact that numbers can sometimes be given an "at least" reading (Mandel, in press; Musolino, 2004). Sentences containing the modal verbs *can* and *will* are completed in a corresponding fashion, with *can* suggesting top values, as *possible,* and *will* showing a similar pattern as *certain* (Teigen & Filkuková, 2013).

1.3. Framing of time

For most dimensions the distinction between the "high" and the "low" end is unproblematic, corresponding to high versus low numerical values on a measurement scale. So for instance, higher performance of a battery means longer battery life measured in hours. But in some domains, and in some contexts, higher achievements are actually associated with low numerical values. When performance speed is an issue, few hours to complete a task reflect a higher level of performance than many hours. Thus the work time dimension is psychologically reversible, with maximal achievements sometimes corresponding to high and sometimes to low values. This may, in turn, be reflected in the usage of verbal expressions associated with high or low performances.

For instance, in one experiment reported by Teigen et al. (2014) participants were asked to complete sentences containing the expressions *can* or *possible* after reading a vignette about a woman driving to work. She claimed that her travel time could range from 20 to 40 min depending on traffic. In one condition the sentence to be completed was given a passive wording, highlighting the duration of the travel ("It can take me _____ min to drive to work"). In the other condition focus was on the driver's performance, suggesting speed ("I can drive to work in _____ min"). The first type of statements led participants to insert high numeric values (40 min), but in the second condition, where the driver's activity is emphasized, most participants selected the lowest numeric value (20 min). This confirms that *can* and *possible* are used to describe extreme, "top" instances in a range of outcomes, while at the same time demonstrating that the location of the "top" depends on the way the statement is formulated.

In a way, the two statements in the above experiment can be described as two attribute framing conditions (Levin, Schneider, & Gaeth, 1998). In typical studies of attribute framing, the same attribute is described in two different, but complementary ways. For instance, a can of soup is described as containing "2% fat" or as being "98% fat free" (Moxey & Sanford, 2000), with the purpose of demonstrating how the different descriptions influence the judgments and decisions of the recipients of the message. In the travel time experiment, the purpose was rather to identify which outcome in a range people find most suitable given two different descriptions. Thus, if travel time to work varies between 20 and 40 min it is equally "true" to say that "it

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