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Lapse resistance in the verbal letter reporting task

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Abstract

Lapses, or misreporting errors, can affect accuracy of threshold measurements. Assumptions about lapse rate, especially in untrained observers, have consequently guided the design of at least one clinical psychophysical test. Lapse rate was assessed using a verbal letter identification paradigm like that used in visual acuity and letter contrast sensitivity testing. Subjects occasionally made slip-of-the tongue errors but spontaneously corrected them. Lapse rate (excluding such errors) was 0–3 errors per 1536 (average rate of 0.0005). In this common clinical paradigm, in which observers set their reporting pace, and where opportunity to amend responses is available, lapse rate is negligible.

Keywords: Lapse rate; Misreporting rate; Extraneous noise; Clinical psychophysics; Acuity; Contrast sensitivity; Psychophysical testing; Psychometric function

1. Introduction

Lapses, also called misreports, or extraneous noise are errors that are unrelated to failures of stimulus detection or discrimination. They can occur even when an observer detects, discriminates, and identifies the stimulus perfectly. They may occur because the observer fails to pay attention to the task, because they are attending to the wrong stimulus, or in the case of automated psychophysical testing, because they have blinked, or have inadvertently pressed the wrong response button.

Lapse rate is usually modeled as λ, the departure from perfect performance in the upper asymptotic region of the psychometric function (ψ; see Fig. 1). Lapses are most evident at the upper asymptote of ψ, where they prevent perfect performance, but they may occur at any stimulus intensity. When they occur well below threshold in the lower asymptotic region of ψ, they have the same effect as chance responding and are thus moot. When they occur in the region of ψ where the slope is positive, they are an additional source of performance variance.

Because lapses are by definition unrelated to sensory aspects of performance, they are of limited substantive interest to psychophysicists, but because they can affect fitting of psychometric function data, their potential effects must be addressed. Failure to account for them accurately can result in biases and decreased precision of slope and location (threshold) parameters of ψ (Swanson & Birch, 1992; Wichmann & Hill, 2001). Since obtaining these parameter values, especially threshold, is often the sole purpose for collecting psychometric function data in the first place, it is important either to use models that are not sensitive to lapses, or to have a means to determine, with reasonable confidence, what the lapse rate is.

Lapses are, to most experimenters, a nuisance. Because they occur infrequently, it is difficult to independently accurately estimate their rate. They may be estimated by adding lapse rate as another free parameter in a performance model, but to do so greatly increases the amount of data that must collected, for a given

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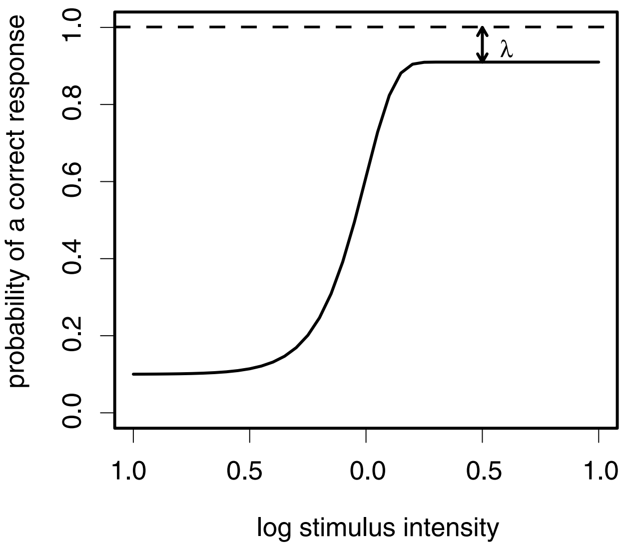

Fig. 1. The Weibull functional form of the psychometric function, showing λ, the lapse rate, as the departure from perfect performance, when stimulus intensity is substantially above threshold. In this example, the probability of a correct guess and the lapse rate are both 0.1.

goodness-of-fit (Klein, 2001). They are especially important to consider in the development of good clinical tests (Pelli, Robson, & Wilkins, 1988), which, for reasons of efficiency, must make assumptions about psychometric function parameters other than the one of interest (usually threshold), rather than estimate them from the data. Lapses are generally presumed to occur more frequently in clinical work than in basic psychophysics (Klein, 2001; Pelli et al., 1988), making it especially important to use paradigms in that setting that can be shown to have high accuracy even when substantial lapses are expected (Pelli et al., 1988) or that can be shown to have very low lapse rates (Swanson & Birch, 1992).

The purpose of this study is to assess frequency of lapses in the task of verbally reported letter identification as typically used in clinical visual acuity and contrast sensitivity measurements. Note that it is impossible to empirically estimate lapse rate at or near threshold, because in this region errors of detection or discrimination may be due *either* to sensory or extraneous factors, and there is no way to know which of these caused the errors. It is only in the upper asymptotic region where sensory factors can be ruled out, where the stimulus is unequivocally detectable, that empirical lapse estimates can be made. Thus, the measurements reported here all use unequivocally legible, decipherable, and suprathreshold stimuli.

2. Methods

Lapse rate was measured in 10 normally sighted, naïve observers, aged 22–82 years, using randomly generated, large, high contrast Sloan letters (Sloan, 1959) printed on white, letter size (8.5 × 11 in.) paper. Letters are used as optotypes in many clinical tests, including the Pelli–Robson Contrast Sensitivity Test (Pelli et al., 1988), the Mars Letter Contrast Sensitivity Test (Arditi, 2005), and the ETDRS acuity charts (Ferris, Kassoff, Bresnick, & Bailey, 1982). The use of large, high contrast letters made it reasonable to assume that errors observed were truly lapses and not related to problems in seeing or encoding the letters. The use of normally sighted observers made it reasonable to assume that errors were not due to a visual disorder.

Letters on each page were arranged in eight rows of six letters each, as on an acuity chart (except that the letters were all large—1.75 cm on a side, 2° at 50 cm, just discernible at that distance with acuity of 20/480), or a letter contrast sensitivity chart (except that the letters were all high contrast—close to 1.0). The letter sequence was random, except that, as in most letter test charts, the same letter never appeared in adjacent positions either vertically or horizontally. The first page of the 32-page sequence is shown in Fig. 2.

No practice was given, and the only experience subjects had in the specific task of reading large high contrast letters was presumably through prior routine eye care, screenings, and driver's licensure.

Participants were simply asked to read the letters aloud while holding the pages at a comfortable distance or on the table before them. The simple instruction to

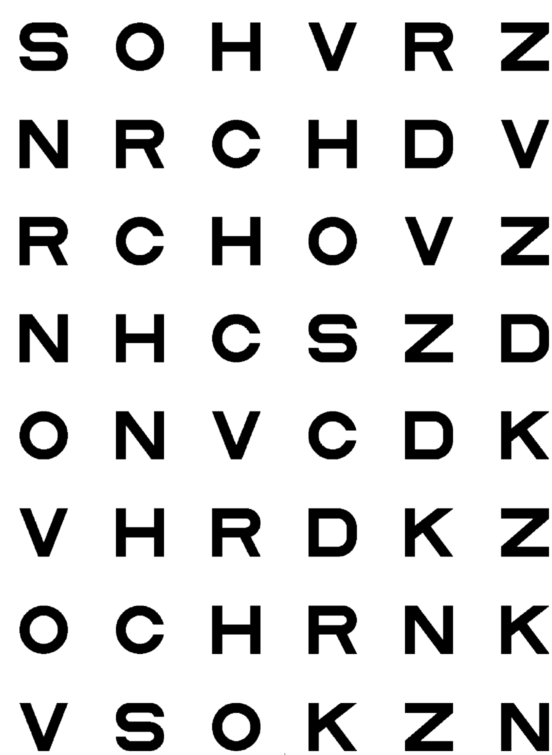

Fig. 2. Sample (first page) of the sequence of letters used in the experiment. Actual size of the page was 8.5 × 11 in.