AN AVERAGING MODEL FOR THE INTEGRATION OF "DREAD" AND PROBABILITY IN SELF-MEDICATION PROPENSITY

Miguel Oliveira* moliveira@fpce.uc.pt

Armando Oliveira* l.dinis@fpce.uc.pt

* *Institute of Cognitive Psychology-University of Coimbra, Portugal*

Abstract

Integration of affective (dread) and probability information associated with medical drugs side-effects was studied through an integration task, with numerical judgments of intake propensity as a response (0-20 rating scale). A "dread" factor (manipulated through severity of reported side effects) and a probability factor, with three levels each, were fully crossed in a factorial within-subjects design. Stimuli consisted of vignettes embodying all factor level's combinations, with three distinct instances (replications) for each condition. An additive integration pattern corresponding to equal-weighting averaging was found. Functional measurement of factor weights, on a ratio scale, revealed greater importance (informativeness) of the dread factor to the overall judgment.

As the coin reverse of prescription nonadherence (e.g., why do people skip their medicine?), self-prescription/medication has developed into a major concern of public health policies. While promoting responsible self-medication is an advocated path in developing countries and the enlargement of «over-the-counter» (OTC) drugs is debated in developed ones, the risks of self-medication with antimicrobials, for instance, go on being emphasised as a world-wide medical problem which favours the emergence of human pathogens resistance (Gasman, 1999; see also Chang & Trivedi, 2003).

Just as with prescription adherence, no single factor accounts for self-medication propensity. Factors vary, moreover, with the specific illness and with patient's age. Among the common identified determinants, however, medication side-effects appear as a chief one. They typically involve two strands of relevant information, concerning the seriousness/severity of side-effects, on one hand, and their prevalence on another. By taking them as factors in an integration task, the present work purports to study how these two classes of informers combine into determining self-prescribed drug consumption. Since severity of side-effects typically induces varying degrees of fear, it is regarded as a primarily "evaluative-affective" factor (*dread*); extent of occurrence is made operational through probability information (one of several possible numerical formats) and thus corresponds to a prima-facie "cognitive" factor (*probability*).

As a plausible starting hypothesis, in line with classical SEU theory (Savage, 1972), a multiplicative-type model "dread x probability" might be envisioned. Within the IIT tradition, several illustrations of multiplicative rules for the combination of "expectancy" and "evaluative" informers can be found, as in Klitzner's (1977) study of snake phobics or Anderson & Shanteau's (1970) study of subjective expected value. Moreover, from the standpoint of general theory, multiplication offers a suitable candidate mechanism to the "amplification" function attributed to affect (Tomkins, 1995). If that was to be the case, a typical "linear fan" should emerge in the factorial plots together with a specific statistical pattern of the interaction term (see Anderson, 1982). Any different outcome would signal the failure of the multiplicative assumption and eventually call upon a different rule.

Besides its intrinsic interest, asserting an algebraic integration model grants the benefit of allowing for functional measurement of the stimuli. To achieve advances in quantifying "affective" and "cognitive" factors on a common unit metric and eventually (contingent on the rule found) tackle the issue of their relative importance in decision-making settings thus becomes an additional prospect of this approach.

Method

Subjects: 59 undergraduate psychology students at the University of Coimbra participated in exchange for course credits.

Stimuli: a set of vignettes staging subjects who endure common symptomatic conditions (e.g., nausea) and consider of using drugs kept at their home pharmacy to obtain relief; when reading the medicine package insert, subjects learn about one associated side-effect, with a given probability of occurrence. The information provided by the insert is made to embody the full crossing of levels of "dread" (low, moderate, and high severity) and "probability" (1%, 5%, and 10%). The chosen range of probability levels reflects the ecological fact that even moderate probabilities of occurrence of side-effects are not allowed for by safety standards. Some vignettes only reported information on side-effect severity or on probability of occurrence, corresponding to the presentation of isolated levels of each factor.

Design & Analysis: The experiment obeyed a full factorial 3 (dread) x 3(probability) within-subjects design, with three replications (different instances of low, moderate, or severe side-effects). Both one-way sub-designs (isolated levels of "dread" or of "probability") were added to the main design. Analysis was carried out through repeated measures ANOVA performed over raw data.

Procedure: stimuli were randomly presented on a computer screen. Participants were instructed to imagine themselves in the situation depicted by the vignettes, and to rate their leaning towards drug intake in a 0-20 scale - 0 standing for "none at all" and 20 for "sure intake". Prior to the experimental task, subjects went through a number of practice trials, resting on vignettes that concerned not drug intake, but instead common technological (e.g. proximity to electromagnetic fields), transportation (e.g. train use), or sports (e.g. parachuting) associated risks.

Results

Cognitive algebra

Figure 1 presents the factorial plots of mean rated intake propensity against severity of side effects (dread), in the abscissa, with probability of occurrence (probability) as the curve parameter. Clear parallelism of the curves signals an additive-type integration model, and rules out multiplying. Also, the cross-over obtained from the dashed line (standing for levels of dread presented in isolation) rules out adding-summing and establishes an *equal-weight averaging rule* (Anderson, 1981, 215-217). Statistical analysis supports the outcomes of visual inspection, by revealing significant main effects of both factors [$F(1.46, 83.27) = 52.07$ for *Dread*, and $F(1.61, 91.56) = 128.49$ for Probability; $p = 0.000$ in both cases] and a non-significant interaction term [$F(3.14, 178.96) = 2.110$; $p = 0.098$] (all "*F*s" with Greenhouse-Geisser correction).

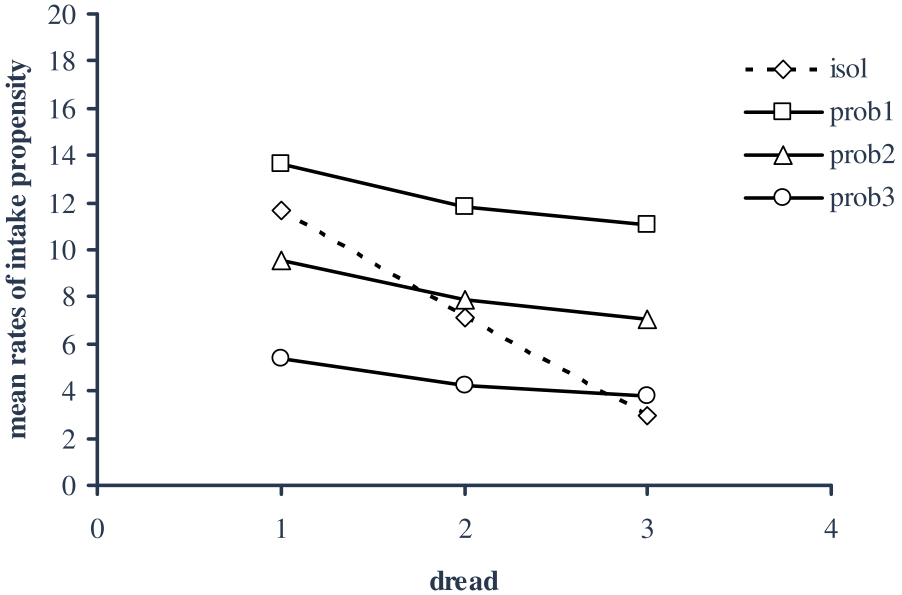

Figure 1 – Factorial plots of "Dread" (abscissa) x "Probability" (parameter), with mean rates of drug intake propensity as a response (ordinate)

Functional measurement

General additivity makes legitimate to take marginal means as functional (subjective) values of the stimuli. However, those values confound the proper scale value (magnitude) and importance (weight) of the informer in its global contribution to the overall response. Differently from other rules, averaging allows for separate estimations of scale value and weight/importance. This requires iterative estimation procedures, and was achieved via the program AVERAGE (Zalinski & Anderson, 1991). Table 1 presents the mean of the obtained weight estimates for Dread and Probability (and their standard deviations).

A paired-samples *t* test revealed a significant difference in weight/importance between *Dread* and *Probability* [t_{58}=12.27, p (2-tailed) = 0.000], at the advantage of *Dread* (mean difference = 6.1). Since weight estimates are on a ratio scale, it can be said that the "informativeness" of a "Dread" informer is roughly twice the one of a "probability" informer, regarding overall intake propensity.

Table 1: Mean and SD (within parenthesis) of Weight estimates

Dread	Probability
11.72 (2.13)	5.61 (3.10)

Discussion

An equal-weight averaging integration of the information on "severity" of side-effects (affect-laden) and on "probability of occurrence" (prima-facie cognitive) could be established. This finding disclaims the *a priori* plausible assumption, grounded on common "*value* x *expectancy*" models, of a multiplying operation. As for the amplifying function commonly ascribed to affect, it appears to be able to exert itself generally through a "weighting" mechanism, and not necessarily through a multiplying one. Functional measurement allowed for by the averaging rule made it possible to quantify the importance/informativeness of the "affective" source (fear/dread) as being about twice the one of the "cognitive" source (probability).

On the side of possible drawbacks of the study, the range of selected probability values, exceeding somewhat the very low occurrence of side-effects imposed by safety standards, might have resulted in artifactual patterns. The absence of any suggestion of floor effects in the data convincingly argues against that possibility. Also, it is clear that important implicit factors might have been influencing the results, such as the symptomatic condition for which relief is sought. The strategy followed in the vignettes was to restrict symptomatic conditions to instances of *low gravity* (although annoying and potentially lasting). Overall consistency of the averaging rule across subjects suggests a reduced impact of this implicit factor. However, the possibility cannot be excluded that by using other sorts of symptoms, of varying gravity, either the rule, the functional values of the stimuli, or both, may undergo significant changes.

The finding of an integration rule opens way to a broader use of cognitive algebra and functional measurement in this and related fields. One obvious extension would be to compare the effect of different numerical formats for communicating "degree of occurrence", such as "relative frequency" versus "probability" - a core issue of risk communication and management. Calling upon other factors known to be relevant both to self-medication and prescription adherence (such as cost, complexity and duration of medication intake, belief in therapeutic efficacy, etc.), targeting specific illnesses or populations (e.g., elderly patients), or expanding the focus to other therapeutic measures besides drug consumption, could also be conceived as straightforward extensions of this approach. Overall, outcomes suggest the usefulness of cognitive algebra in laying down an experimental, formal, quantified approach to these highly applied, economically and socially relevant matters.

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