The Visual Acuity of Less: Why People Underestimate Increases But Not Decreases in Quantity

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While we know that quantity increases are strongly underestimated, we find that estimates of quantity decreases are almost perfect. This asymmetry is not caused by loss aversion but by the presence of a natural zero bound which makes downsizing estimation an interpolation task (and supersizing estimation an unbounded extrapolation task).

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EXTENDED ABSTRACT

We examine whether people perceive the magnitude of physical size increases similarly to how they perceive size decreases. Research in psychophysics and consumer behavior has shown that visual estimates of increases in object size are strongly inelastic, meaning that people strongly underestimate the actual magnitude of the size increase (Chandon and Wansink 2007; Krishna 2007; Stevens 1971). Other studies have indicated that estimates of quantity decreases may be more elastic and thus more accurate (Ordabayeva and Chandon 2013), but no research has directly compared the two types of estimations. Yet, such estimations are common in today’s marketplace, where package sizes increase and decrease frequently (Feltén 2012; Nestle 2003), and where consumers rely on their visual package impressions to judge product size in the absence, and in the presence, of size information (Lennard et al. 2001).

While existing theories may have some bearing on this issue, little research has studied it directly. The psychophysics literature assumes that estimations of size increases and decreases follow the same process and hence are both inelastic. The anchoring and adjustment literature predicts the same degree of anchoring when the anchor is above or below the true value. Prospect theory predicts an asymmetry in the valuation of size gains and losses, but it assumes that size decreases are construed as psychological losses and size increases are construed as gains, and that the magnitude of the size increase and decrease corresponds to the magnitude of the perceived gain and loss.

Importantly, existing theories have overlooked the fact that the estimation of size decreases in physical quantities is distinct from the estimation of size increases in that physical quantities can never be negative. Thus, the natural lower bound (zero) is salient when estimating size decreases, but the natural upper bound is absent when estimating size increases. This makes estimating size decreases an extrapolation task, bounded by the large reference size as well as zero, and estimating size increases an extrapolation task, only bounded by the small reference size.

We build on prior research which showed that interpolation tasks are easier than extrapolation tasks, for object perception and learning of functional relationships between variables (Kellman 2003; McDaniel and Busemeyer 2005). We expect that estimations of decreasing quantities will be less inelastic, and thus more accurate, than estimations of increasing quantities. We expect that the asymmetry between estimations of size increases and decreases will be reduced: (a) when estimations of both size increases and decreases require extrapolation (i.e., when the lower zero bound is removed from estimations of decreasing sizes); and (b) when an upper bound is salient in estimations of size increases.

In Study 1, Mechanical Turk participants saw portions S, M, and L of peanuts containing 52, 182, and 367 peanuts displayed vertically. Given the size of a reference jellybeans portion, they estimated the sizes of peanuts portions. In the supersizing condition, the reference (52 jellybeans) was identical to portion S of peanuts. In the downsizing condition, the reference (367 jellybeans) was identical to portion L of peanuts. Participants also indicated whether portion S at $0.25 or L at $1.50 provided better value for money (L was better at $.23 cents per nut). The results revealed that size estimations were more accurate and people thought that portion L provided better value for money when sizes decreased vs. increased from the reference (portion L appeared to be 9.7 times bigger than S vs. 6.3 times when portions decreased vs. increased, and 92% vs. 81% of participants thought that portion L was better value when portions decreased vs. increased).

In Study 2, experts (chefs at Paul Bocuse Culinary Institute) saw four portions (S, M, L, XL) of mashed potatoes, soup, and salad displayed horizontally in professional containers. In the control condition, participants estimated the final sizes of portions given the size of the reference. For supersizing, given the size of portion S, participants estimated portions M, L, and XL. For downsizing, given the size of portion XL, participants estimated portions L, M, and S. In the factor of change condition, participants estimated how many times larger one portion was than another. For supersizing, they estimated how many times larger portions M, L and XL were than S. For downsizing, they estimated how many times larger portion XL was than L, M, and S. The factor of change estimation forced the estimators to range between 1 and infinity, which required extrapolation. The results revealed that size estimations were more accurate for downsizing than supersizing when estimating final sizes of portions (L appeared to be 14.10 vs. 10.54 times bigger than S for downsizing vs. supersizing), but not when estimating factors of change between portions (L appeared to be 11.64 vs. 11.71 bigger than S for downsizing vs. supersizing).

Study 3 replicated these results with novices (Mechanical Turk participants) and two factor of change conditions which had people estimate either the larger factor (how many times larger one portion was than another) or the smaller factor (how many times smaller one portion was than another).

In Study 4, participants estimated increasing or decreasing amounts of iced tea and jellybeans displayed in identical glasses. The same size (M) served as a reference across conditions (people estimated L, XL for supersizing; S, XS for downsizing) to rule out reference size effects. We varied the palatability of the iced tea (by adding sugar or salt) and jellybeans (by using regular or disgusting flavors) to rule out prospect theory as an alternative explanation. Participants estimated final sizes, or poured the required quantities of product into or out of the glass, which was naturally bounded by the edges (bottom and top) of the glass and required interpolation. As predicted, the asymmetry emerged when estimating portions, but not when pouring portions – independent of palatability (which ruled out prospect theory).

Study 5 further confirmed the role of estimation bounds and extended their effects beyond food products by showing that the asymmetry was eliminated when an explicit numeric upper bound limits estimations of the size of a file download.

REFERENCES


