Slant matching task

Figure S1: Slant matching experiment response screen. Stimuli depicted the observer (oval) looking at the fixation (black square) as seen from the top. Observers had to report how slanted the RDK appeared relative to the fronto-parallel plane (tilted and horizontal black lines), by changing the orientation of the cursor line using the computer mouse.

We studied the build-up of perceived slant in our HSR stimulus using Van Ee & Erkelens (1996) slant matching technique. We used the same stimuli (HSR) and apparatus as in Experiment 1. Stimuli were displayed for 0.1, 0.3, 1.0, 3.1 or 10 seconds. The surface could have one of 7 slant values: -60, -40, -20, 0, +20, +40 or +60 degrees. After the stimulus was displayed, observers had to report the slant they perceived relative to the fronto-parallel plane by rotating a line depicting the stimulus as seen from the top using the computer mouse (see Figure S1). Observers performed 10 trials in each condition (350 trials total).
Figure S2: Results from 4 observers (O1-4). Average (thin colored lines) perceived slant (ordinate) is plotted as a function of geometrically defined slant (abscissa) and display durations (blue to red).

Figure S2 shows average reported slant as a function of geometrically defined slant and display duration. Reported slant increased with geometrically defined slant. Reported slant also increased slightly with display duration. As prior studies, we found that observers consistently reported lower slant angles than is defined geometrically in the stimulus. To estimate these effects we linearly regressed the average reported slant as a function of geometrically defined slant:

\[ S_r = g \cdot S_g + b \]

With \( S_r \) and \( S_g \) the “reported” and “geometrically defined” slants, \( g \) and \( b \) the observers’ gain and bias.

At the longest display duration, of 10s, observers reported on average only 76% of the slant that was geometrically defined in the stimulus, a value comparable to prior studies. At the shortest display duration of 0.1s, observers already reported 57% of the slant.

Figure S3(A) plots the observers’ sensitivity (gain \( g \) of the linear regressions), which corresponds to the ratio of reported perceived slant over geometrically defined slant. To estimate this effect we regressed in turn these
gains as a function of display duration. Reported slant significantly increased with 
display duration for all 4 observers (resampling, p<0.01).

Figure S3(B) plots the observers' biases (intercept $b$ of the linear 
regressions) as a function of display duration. Some observers were slightly 
biased, but this bias was stable over display duration. The slope of the biases 
regressed across display duration was significantly different from 0 for none of the 
observers (resampling, $p=0.28$, $p=0.50$, $p=0.48$ and $p=0.58$).

In conclusion we found that observers underestimated the slant, and that 
perceived slant increased with display duration (slant build-up). However, in sharp 
contrast with prior studies which found that observers were unable to report any 
slant at short display durations (see Table S1); in this experiment even at the 
shortest display duration observers already reported almost as much slant as for 
the longest display duration (over 75% of the slant reported at the longest display 
duration). Moreover in this series of experiments we ran over 20 separate 
observers (some ran in more than one experiment), all of whom reached near 
100% of correct answers in less than 500ms. This suggests that the slow build-up 
of perceived slant is more likely related to cue conflicts in poorly controlled slant 
stimuli instead of an intrinsic sluggishness of the stereo slant system.

<table>
<thead>
<tr>
<th>Study</th>
<th># observers</th>
<th># perceived slant at shortest display duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Ee &amp; Erkelens (1996)</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Van Ee &amp; Erkelens (1998)</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Allison, Howard, Rogers &amp; Bridge (1998)</td>
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<td>0</td>
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<tr>
<td>Allison &amp; Howard (2000)</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Bradshaw, Gillam &amp; Hibbard (2002)</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Table S1: List of studies that studied the build-up of perceived slant with display 
duration (column 1). Column 2 lists how many observers participated in these 
studies. Column 3 lists how many observers reported over 20% of geometrically 
defined slant with an HSR stimulus (an arbitrary criterion). Bradshaw at al. (2002) 
varied display duration to reach a 79% threshold and found display durations of over 
1s for their HSR stimulus. Note that some observers presumably ran in more than 
one experiment (JZ and RE in Van Ee & Erkelens (1996 & 1998), and HJ, JZ, RA & 
XF in Allison et al. (1998) and Allison & Howard (2000)).