

Explicit and implicit depth-cue integration: evidence of systematic biases with real objects

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Manuscript Source: <https://www.biorxiv.org/content/10.1101/2021.03.19.436171v1>

Manuscript Authors: Carlo Campagnoli, Bethany Hung & Fulvio Domini

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Research Paper Sections:

The sections of the research paper input text parsed in this audit.

[illegible]

Title **Explicit and implicit depth-cue integration: evidence of systematic biases with real objects**

S1 [001] Abstract

S1 [002] In a previous series of experiments using virtual stimuli, we found evidence that 3D shape estimation agrees to a superadditivity rule of depth-cue combination.

In a previous series ...
... of experiments ...
... using virtual stimuli, ...
... we found evidence ...
... that 3D shape estimation agrees ...
... to a superadditivity rule ...
... of depth-cue combination.

S1 [003] According to this rule, adding depth cues leads to greater perceived depth magnitudes and, in principle, to depth overestimation.

According ...
... to this rule, ...
... adding depth cues leads ...
... to greater perceived depth magnitudes and, ...
... in principle, ...
... to depth overestimation.

S1 [004] The mechanism underlying the superadditivity effect can be fully accounted for by a normative theory of cue integration, through the adaptation of a model of cue integration termed the Intrinsic Constraint (IC) model.

The mechanism underlying the superadditivity effect can be fully accounted ...
... for by a normative theory ...
... of cue integration, ...
... through the adaptation ...
... of a model ...
... of cue integration termed the Intrinsic Constraint ...
... (IC) ...
... model.

S1 [005] As for its nature, it remains unclear whether superadditivity is a byproduct of the artificial nature of virtual environments, causing explicit reasoning to infiltrate behavior and inflate the depth judgments when a scene is richer in depth cues, or the genuine output of the process of depth-cue integration.

As ...
... for its nature, ...
... it remains unclear ...
... whether superadditivity is a byproduct ...
... of the artificial nature ...

... of virtual environments, ...
... causing explicit reasoning ...
... to infiltrate behavior ...
... and inflate the depth judgments ...
... when a scene is richer ...
... in depth cues, ...
... or the genuine output ...
... of the process ...
... of depth-cue integration.

S1 [006] In the present study, we addressed this question by testing whether the IC model's prediction of superadditivity generalizes beyond VR environments to real world situations.

In the present study, ...
... we addressed this question ...
... by testing ...
... whether the IC model's prediction ...
... of superadditivity generalizes ...
... beyond VR environments ...
... to real world situations.

S1 [007] We asked participants to judge the perceived 3D shape of cardboard prisms through a matching task.

We asked participants ...
... to judge the perceived 3D shape ...
... of cardboard prisms ...
... through a matching task.

S1 [008] To assay the potential influence of explicit control over those perceptual estimates, we also asked participants to reach and hold the same objects with their fingertips and we analyzed the in-flight grip size during the reaching.

To assay the potential influence ...
... of explicit control ...
... over those perceptual estimates, ...
... we also asked participants ...
... to reach ...
... and hold the same objects ...
... with their fingertips ...
... and we analyzed the in-flight grip size ...
... during the reaching.

S1 [009] Using physical objects ensured that all visual information was fully consistent with the stimuli's 3D structure without computer-generated artifacts.

Using physical objects ensured ...
... that all visual information was fully consistent ...
... with the stimuli's 3D structure ...
... without computer-generated artifacts.

S1 [010] We designed a novel technique to carefully control binocular and monocular 3D cues independently from one another, allowing to add or remove depth information from the scene seamlessly.

We designed a novel technique ...
... to carefully control binocular ...
... and monocular 3D cues independently ...
... from one another, ...
... allowing ...
... to add ...
... or remove depth information ...
... from the scene seamlessly.

S1 [011] Even with real objects, participants exhibited a clear superadditivity effect in both explicit and implicit tasks.

Even ...
... with real objects, ...
... participants exhibited a clear superadditivity effect ...
... in both explicit ...
... and implicit tasks.

S1 [012] Furthermore, the magnitude of this effect was accurately predicted by the IC model.

Furthermore, ...
... the magnitude ...
... of this effect was accurately predicted ...
... by the IC model.

S1 [013] These results confirm that superadditivity is an inherent feature of depth estimation.

These results confirm ...
... that superadditivity is an inherent feature ...
... of depth estimation.

S2 [014] Introduction

S2 [015] In previous studies we showed that, when sources of depth information (cues) are added to the virtual rendering of a 3D shape, the perceived magnitude of a given 3D property of that shape (e.g., its depth, slant or curvature) increases.

In previous studies we showed that, ...
... when sources ...
... of depth information ...
... (cues) ...
... are added ...
... to the virtual rendering ...
... of a 3D shape, ...
... the perceived magnitude ...
... of a given 3D property ...
... of that shape ...

... (e.g., its depth, ...
... slant ...
... or curvature) ...
... increases.

S2 [016] For instance, when viewing a cylindrical surface from a close distance (50 cm), its overall depth is consistently underestimated when the shape is only specified by binocular disparity, compared to when specified by a mixture of disparity signals and texture gradient (Campagnoli & Domini, 2019).

For instance, ...
... when viewing a cylindrical surface ...
... from a close distance ...
... (50 cm), ...
... its overall depth is consistently underestimated ...
... when the shape is ...
... only specified ...
... by binocular disparity, ...
... compared ...
... to when specified ...
... by a mixture ...
... of disparity signals ...
... and texture gradient ...
... (Campagnoli & Domini, 2019).

S2 [017] This pervasive phenomenon, which we refer to here as superadditivity effect (the estimated depth from a combination of depth cues is greater than the depth estimates from the individual cues) has been previously observed in the context of a series of perceptual studies investigating a model of depth cue combination termed Intrinsic Constraint (IC) model (Di Luca et al., 2010; Domini & Caudek, 2003, 2009, 2010, 2011, 2013; Domini et al., 2006; Domini et al., 2011; Kemp et al., 2018).

This pervasive phenomenon, ...
... which we refer ...
... to here ...
... as superadditivity effect ...
... (the estimated depth ...
... from a combination ...
... of depth cues is greater ...
... than the depth estimates ...
... from the individual cues) ...
... has been previously observed ...
... in the context ...
... of a series ...
... of perceptual studies investigating a model ...
... of depth cue combination termed Intrinsic Constraint ...
... (IC) ...
... model ...
... (Di Luca et al., 2010; ...
... Domini & Caudek, 2003, 2009, 2010, 2011, 2013; ...
... Domini et al., 2006; ...
... Domini et al., 2011; ...
... Kemp et al., 2018).

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