The Variability of Crater Identification Among Expert and Community Crater Analysts
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Abstract
Statistical studies of impact crater populations have been used to model ages of planetary surfaces for several decades [1], but this assumes that crater counts are approximately invariant and a “correct” population will be identified if the analyst is skilled and diligent. However, the reality is that crater identification is generally subjective, so variability between analysts, or even day-to-day for a single analyst, is expected [e.g., 2-5]. This study was undertaken as the first of its kind to quantify the variability within an expert analyst population using different techniques, and between experts and minimally trained volunteers.

Methods
Images:
Low-Resolution Aonchide Wide-Angle Camera (VAC) and Narrow-Angle Camera (NAC) images M119405713M and M140905972M were processed in ISIS software via standard radiometric techniques and georeferenced to the Moon by Robbins. These were then placed on a server from which the other analysts retrieved them.

Researcher Methods:
There were 8 professional crater analysts who gathered 11 datasets for the NAC and 8 for the VAC (Antonenko and Robbins used multiple interfaces). Seven different techniques used to identify and measure craters, the concept being to “study crater analysts in their natural habitats.” These were: ArcMap software employing rim-tracing (Robbins), CraterTools (Fassett, Canada) [3], Crater Helper Tools (Antonenko, Herrick) [6], or chord-drawing (Singer; JMAR’s crater-measuring tool (Antonenko, Kirchoff); QAO image with custom PERL scripts (Chapman); or the Moon Mappers interface (Antonenko, Robbins; for the NAC image only).

Volunteer Citizen Scientist Method:
Volunteers used the CosmoQuest Moon Mappers online interface (cosmoquest.org) [7], an online portal that presents basic crater identification tools and a 450x450 px sub-image. There are no image manipulation tools provided (e.g., zoom in or out, brightness/contrast/gamma adjustment). The interface requires the volunteer to click on the center of a crater, hold the mouse down, and drag until the rim is reached. It will save the crater if the diameter is ≥18 px.

Data Reduction:
A modified DESCAN [8] code was developed to cluster crater measurements based on diameter-scaled proximity of crater centers and the crater diameter. This algorithm works by taking each crater and searching within a pre-defined scaled location offset and diameter difference (e.g., 10 px offset of a 20-pixel crater is relatively large, but that 10 px offset for a 200-pixel-diameter crater is negligible). Other craters within this distance were considered members of the cluster.

A crater was included in the final export dataset if all of the experts identified it (though in other applications, a different threshold may be appropriate). The threshold for volunteers was set such that at least 60% needed to identify the feature (this gave the best comparison with expert data).

CosmoQuest: http://cosmoquest.org

Find our work online: http://dx.doi.org/10.1016/j.icarus.2014.02.022 || http://youtube.com/NRS5FC-34ss || http://youtube.com/GQF2-G4jNw

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Movie Description of Detailed Results: http://youtube.com/NRS5FC-34ss

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