Supplementary Material:
Learning Physics-guided Face Relighting under Directional Light

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We provide additional examples for the experiments in the main paper and complement our analysis with an investigation of dynamic input lighting and multiple input light sources. The reader is highly encouraged to look at the accompanying video to get a better sense of the dynamic aspects of relighting.

1. Additional results

Relighting with environment maps. As explained in Sec. 6.2 in the main paper, we can relight an input image w.r.t. a given environment map through sampling. In addition to Fig. 6 in the main paper, Figs. 8 and 9 show relighting results for 5 different environment maps, ranging from cold to warm color temperatures.[1]

Relighting in the wild. As an extension to Sec. 6.3 in the main paper, Fig. 10 shows face relighting of images taken with a Canon EOS 6D, outside of our capture environment. All images were taken in an office with relatively diffuse lighting.

Extended baseline comparisons. In Figs. 11 and 12, we extend Fig. 3 in the main paper to show additional comparisons to related work.

2. Dataset details

In order to balance the demographics of the captured data, we split the 21 subjects into a training, validation and test set according to Table 3. We tried to achieve a meaningful distribution of salient characteristics in all of the subsets.

Table 3: **Dataset details.** Distribution of salient characteristics in training, validation and test set.

	female	dark skin	glasses
training	2	3	4
validation	1	1	1
test	1	1	1
total	4	5	6
ratio	19.0%	23.8%	28.6%

3. Additional investigation

3.1. Dynamic input lighting

We illustrate the consistency and robustness of our approach by relighting multiple source light configurations to the same target lighting (see Figs. 13 and 14). Our examples cover a wide spectrum of source illuminations, including strong and challenging directional lights originating on the side of the face. The extreme cases on the far left and right, in particular, require the removal of strong shadows. The noise in these low light areas is high, and visual cues are weak, which makes consistent relighting challenging. Please also refer to the video, where we show results in a dynamic environment with moving lights.

3.2. Multiple input light sources

Our experiments with environment maps show that the extension to multiple output lights is straightforward. Although the case of multiple input lights is less obvious, our model is able to generate meaningful results even when the input image was lit under complex lighting. Indeed, we have already shown results of this type when we discussed relighting in the wild, which does not put any constraints on the source lighting. In order to explore the performance in this regime more systematically, we additionally conducted controlled experiments by using our light stage setup to synthesize multi-illumination images. Since light is additive, we can simply combine captures under lights from different directions to artificially create inputs that were lit by multiple lights. Providing these as input to our model, which violates our model assumption, we still get meaningful results, as can be seen in Fig. 15. Specifically, we sampled 3 input light directions at random to create the input image, then ran our model 3 times, each time providing the combined input image and one of the 3 source light directions. Finally, we compose the corresponding output images.

[1] The 'fire' environment map (last column) was obtained from "BlinkFarm" (www.youtube.com/blinkfarm).

Figure 8: **Relighting with Environment Maps.** We relight the input (first column) w.r.t. 5 different environment maps (first row), ordered from cold (second column) to warm (sixth column) dominating color temperatures. All results have been converted from linear to sRGB.

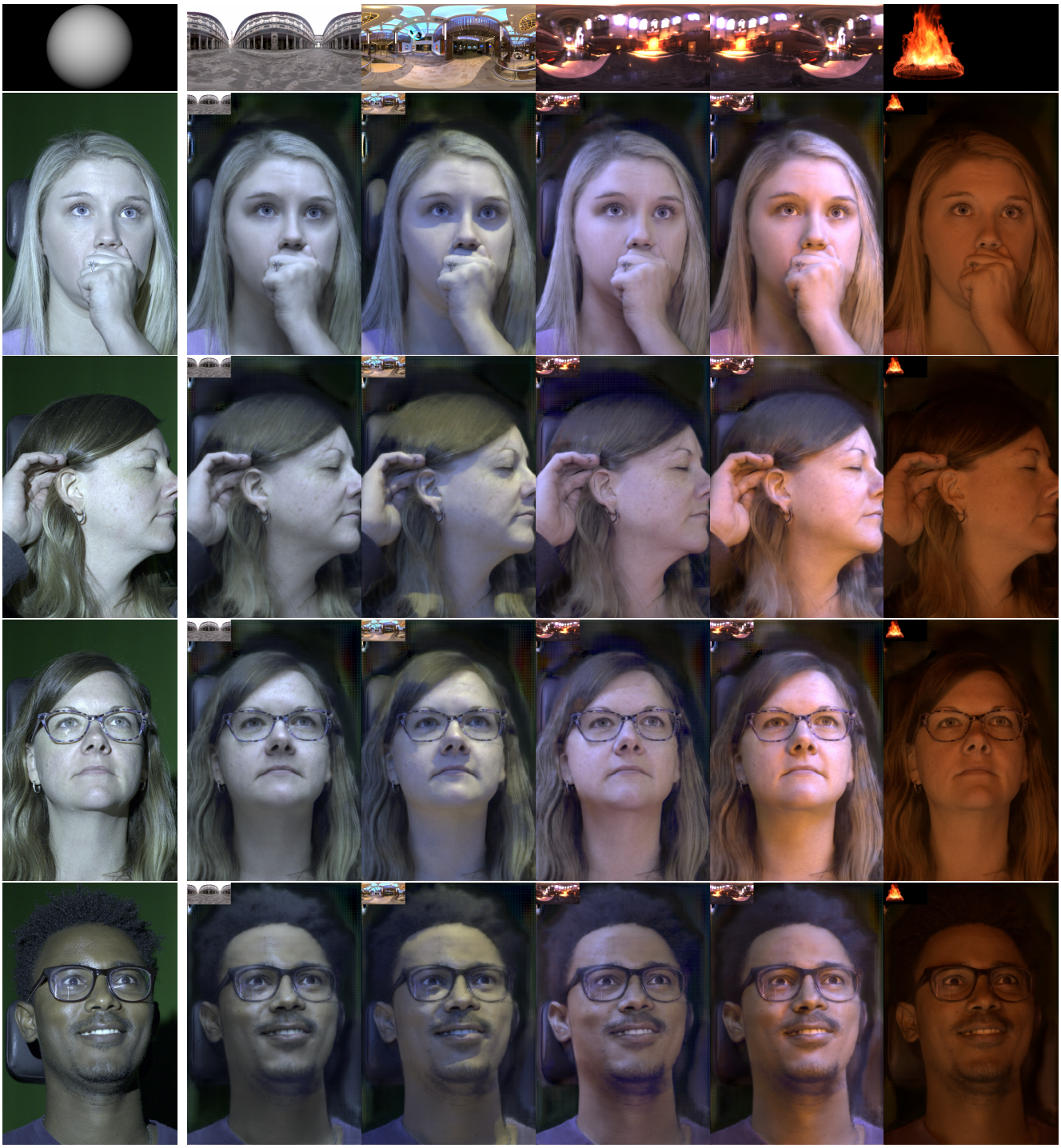


Figure 9: **Relighting with Environment Maps.** We show the same type of visualization as in Fig. 8 but focus on more challenging scenarios, such as expressions affecting the face topology and glasses. All results have been converted from linear to sRGB.

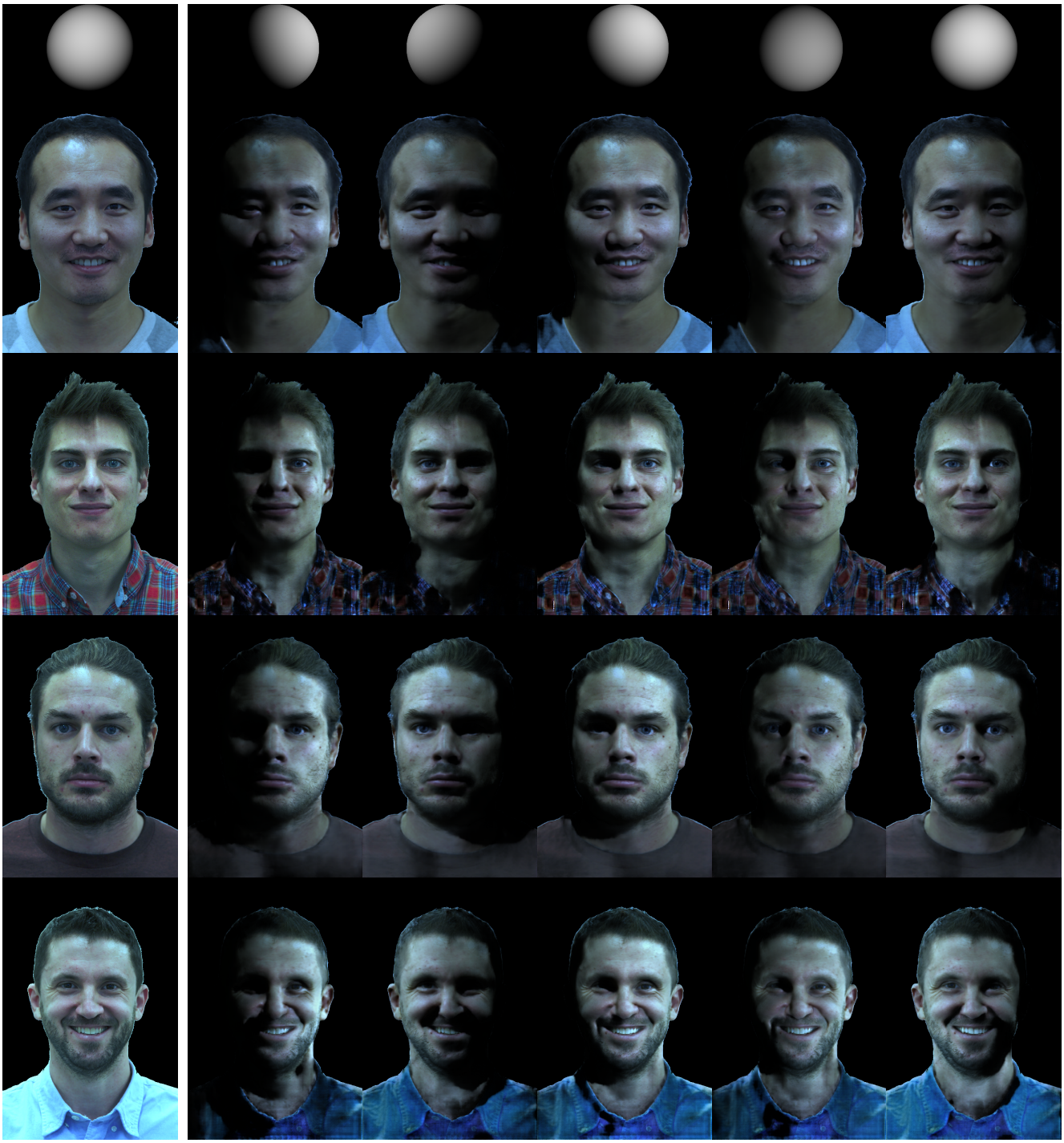
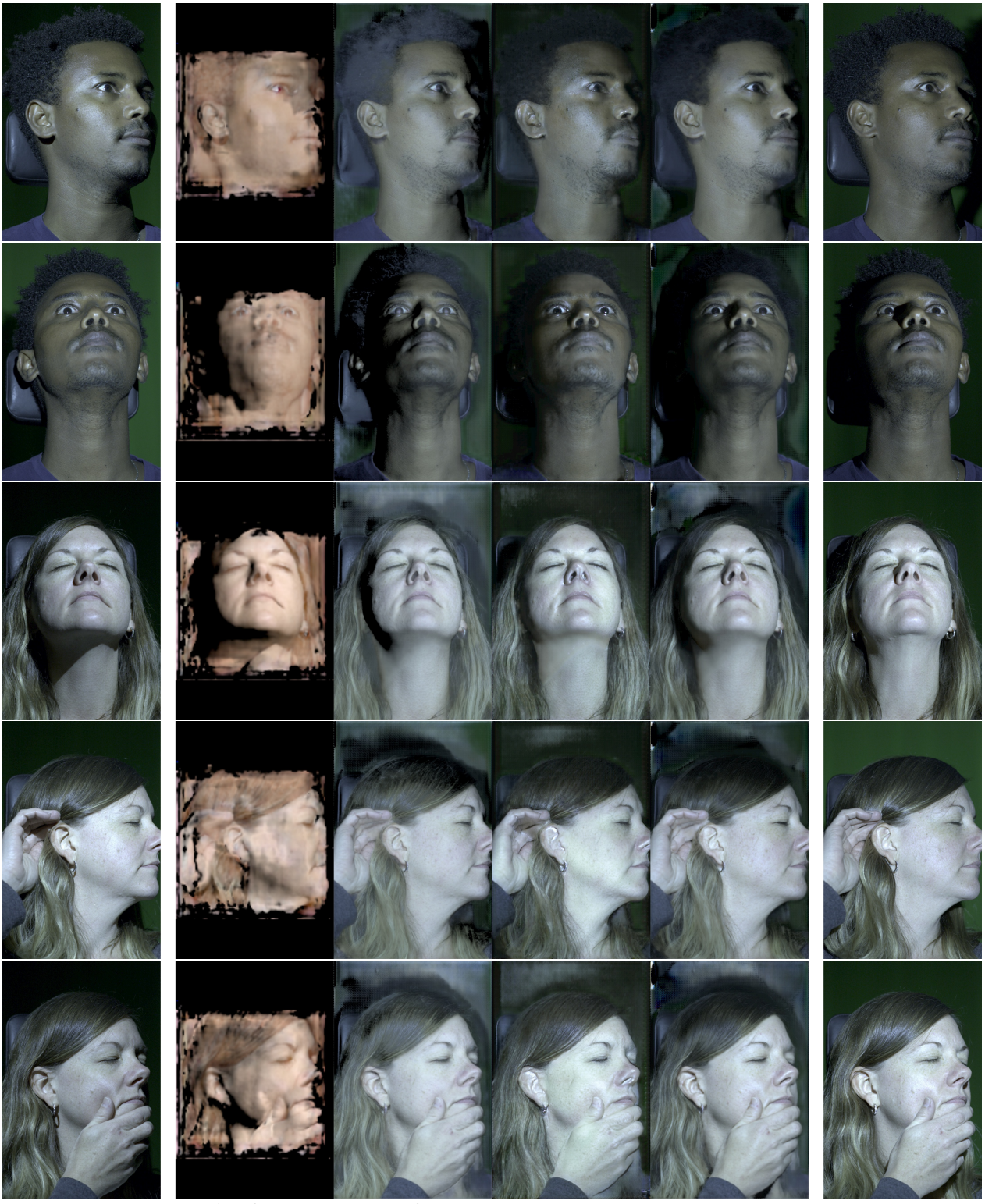


Figure 10: **Relighting in the wild.** We consider portraits not taken in our capture environment (first column) and relight them with respect to 5 different target point lights. Point light directions are visualized by rendered spheres at the top.

(a) input image | (b) SfSNet (pretrained) | (c) SfSNet (retrained) | (d) pix2pix | (e) ours | (f) ground truth

Figure 11: **Extended qualitative evaluation on unseen subjects and expressions.** We compare relighting (**a**) the input image with (**b/c**) pretrained and retrained variants of SfSNet, (**d**) pix2pix, and (**e**) our model. In (**f**), we show the ground truth capture of the given target illumination. All results have been converted from linear to sRGB.

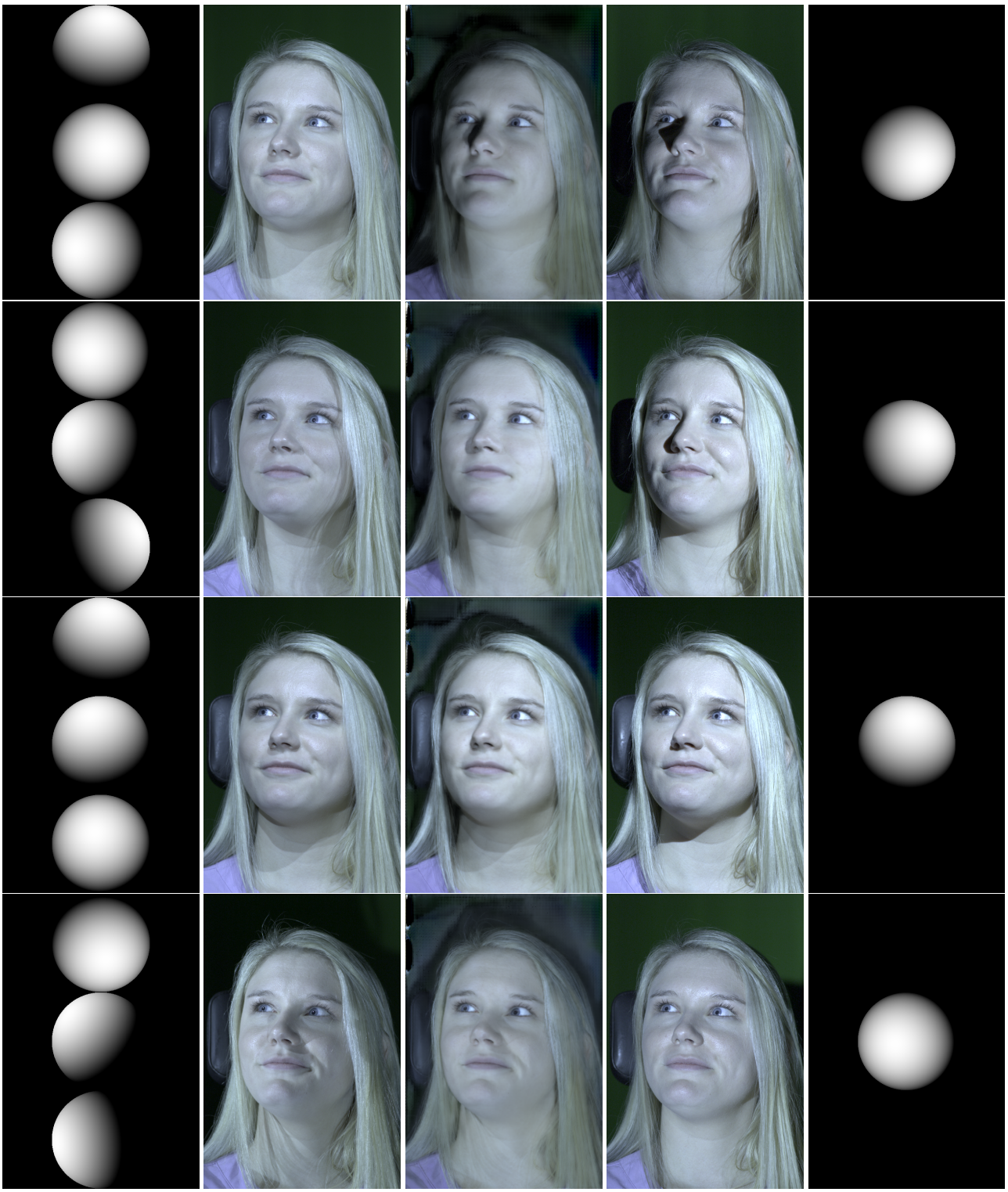


(a) input image | (b) SfSNet (pretrained) | (c) SfSNet (retrained) | (d) pix2pix | (e) ours | (f) ground truth

Figure 12: **Extended qualitative evaluation on unseen subjects and expressions.** We compare relighting (**a**) the input image with (**b/c**) pretrained and retrained variants of SfSNet, (**d**) pix2pix, and (**e**) our model. In (**f**), we show the ground truth capture of the given target illumination. All results have been converted from linear to sRGB.

Figure 13: **Dynamic input lighting.** In each row, we show a different facial expression that we relight from different input light configurations (columns; see small inset) to the same target light configuration. All results have been converted from linear to sRGB.

Figure 14: **Dynamic input lighting.** In each row, we show a different facial expression that we relight from different input light configurations (columns; see small inset) to the same target light configuration. All results have been converted from linear to sRGB.



(a) input light (b) input image (c) ours (d) GT (e) output light

Figure 15: **Multiple input light sources.** Using multiple light sources (**a**), we construct the input image (**b**) and relight it with our model (**c**) towards the desired ground truth (**d**) under the output light direction (**e**).