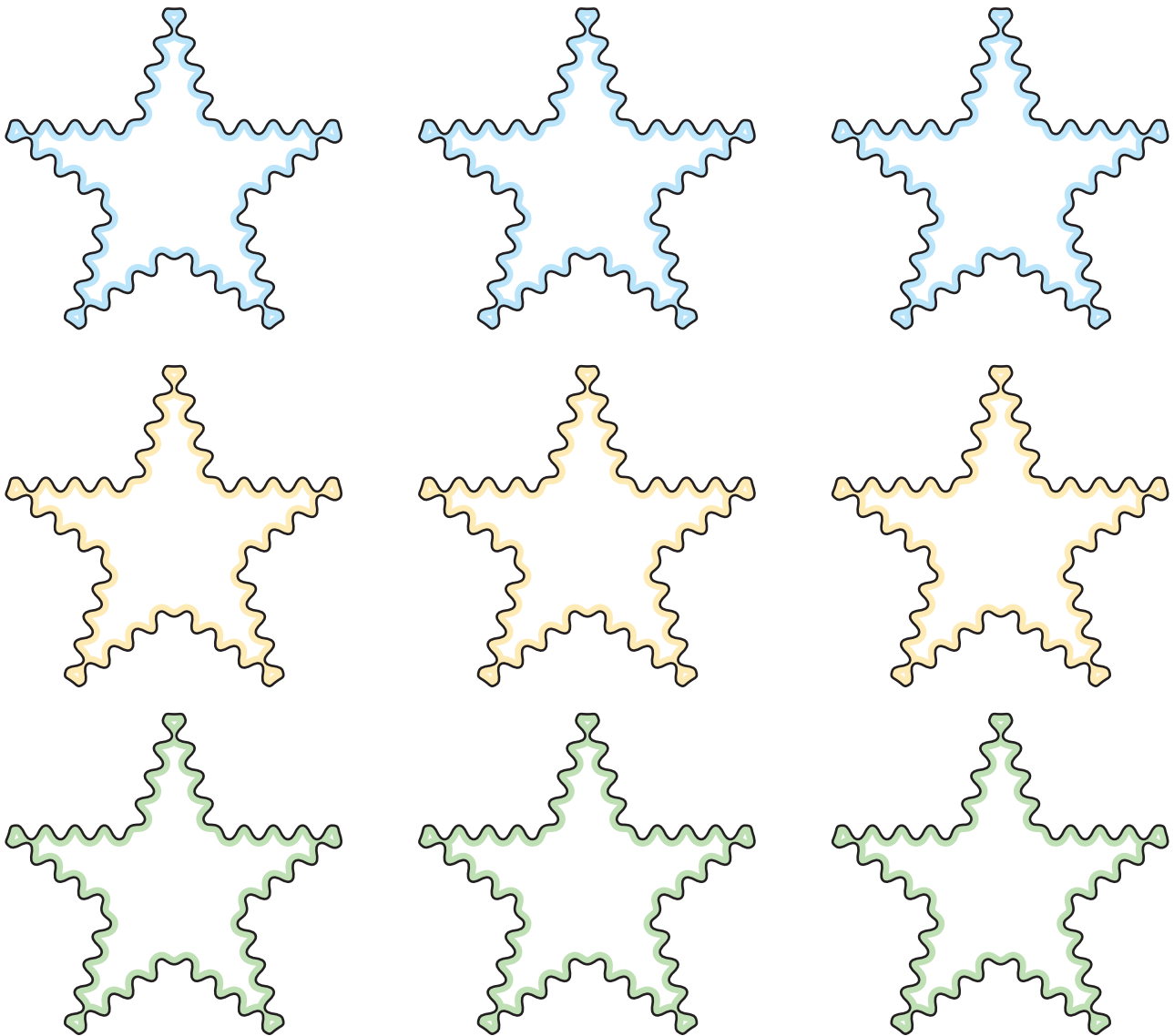


Watercolor illusion

An optical illusion by Baingio Pinna

When a dark-colored outline is flanked by a thin bright color, the brighter color appears to spread into the enclosed white area, causing a watercolor effect. This phenomenon is called watercolor illusion.

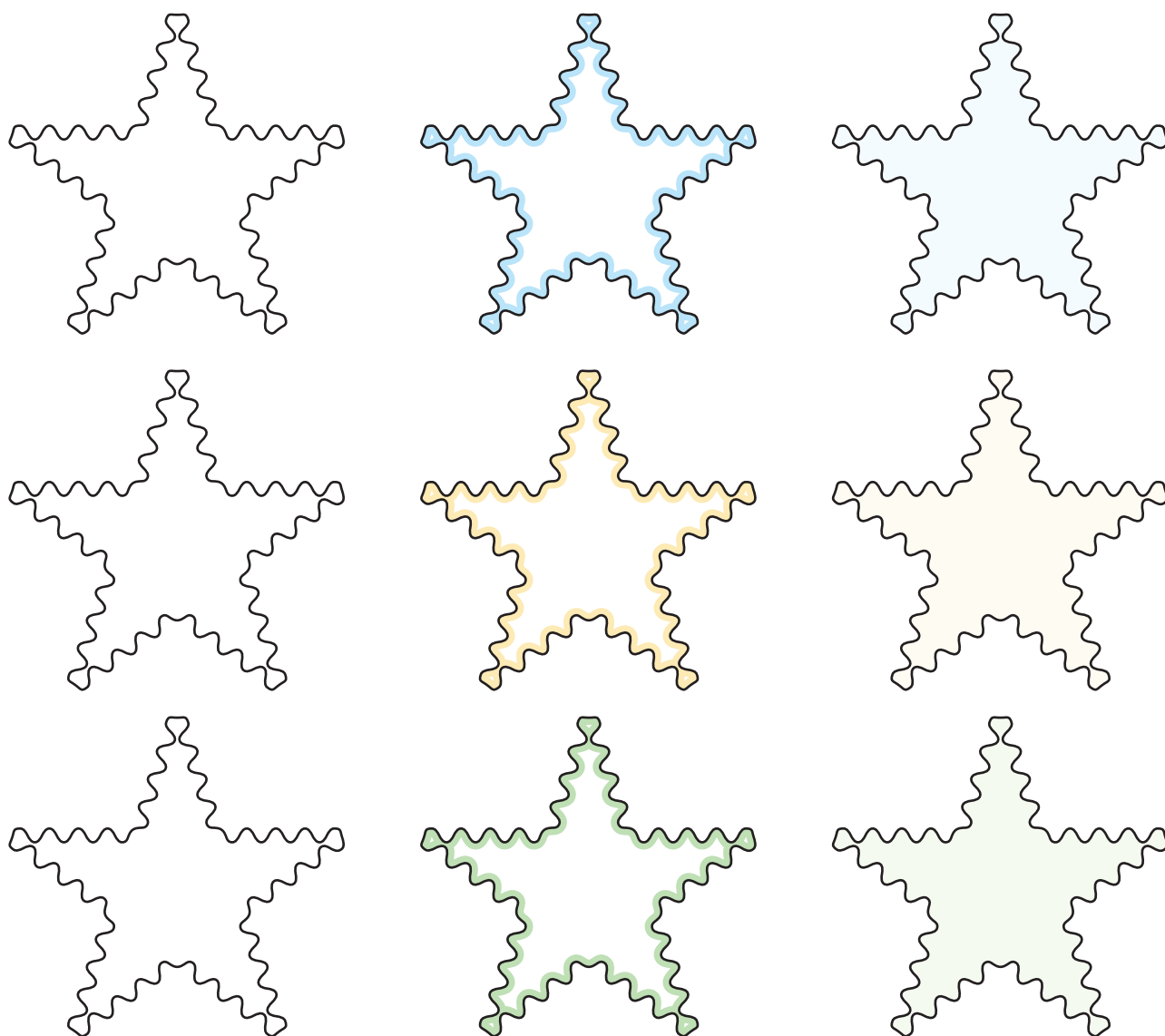
What color are these stars?



The first, second and third rows of stars appear to be blue, yellow and green respectively. But in reality, they are totally white with respective colored thin lines flanking the black outline.

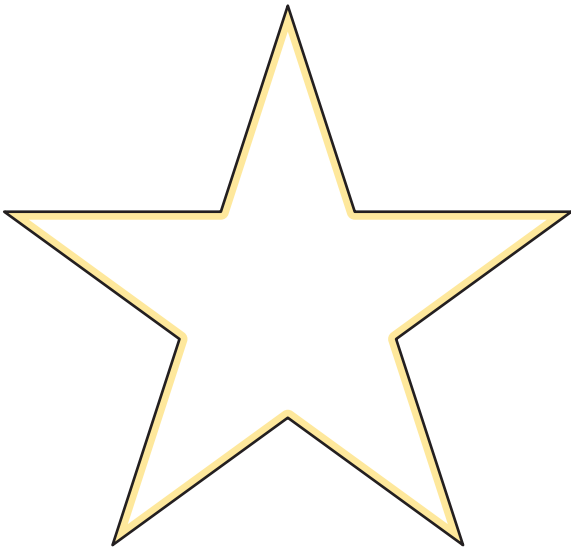
What causes the illusion?

Our brain perceives the darkest color as the border between the figure and the background. When there is an additional color flanking the border, the darker color (black in this case) is perceived as the border of the figure, and the lighter color is perceived as the filling color of the figure. Since the inner border is lighter in color here, the color appears to be spreading inwards. The filling is perceived as the mixture of both the colors, i.e., the actual color of the figure (white) and the lighter colored (blue, yellow or green) line flanking the darker border.

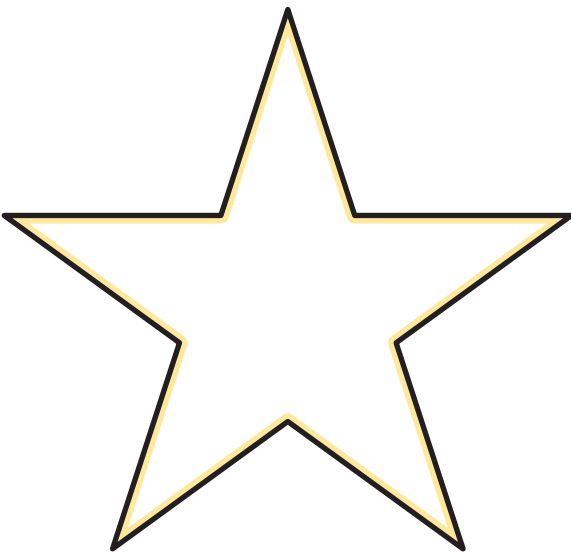


When the light-colored lines are flanked with the black outlines of the stars (stars on the left), the entire areas inside the stars (stars on the right) appear to have a pale tint of the respective colors. The colored outlines mixed with the white background give the appearance of pale colors spreading across the stars.

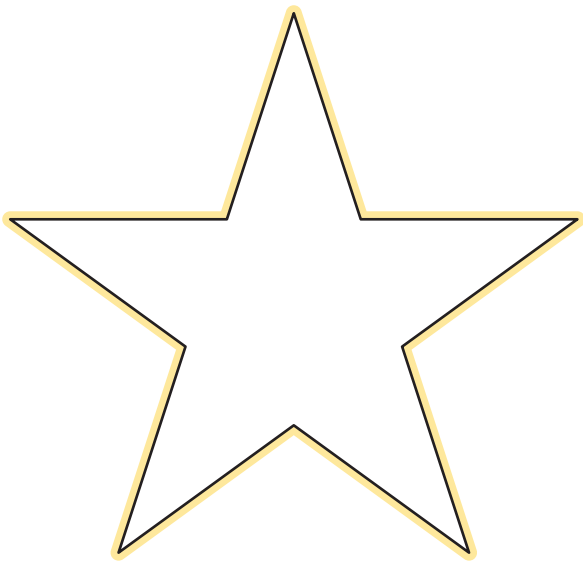
What enhances/diminishes the illusion?



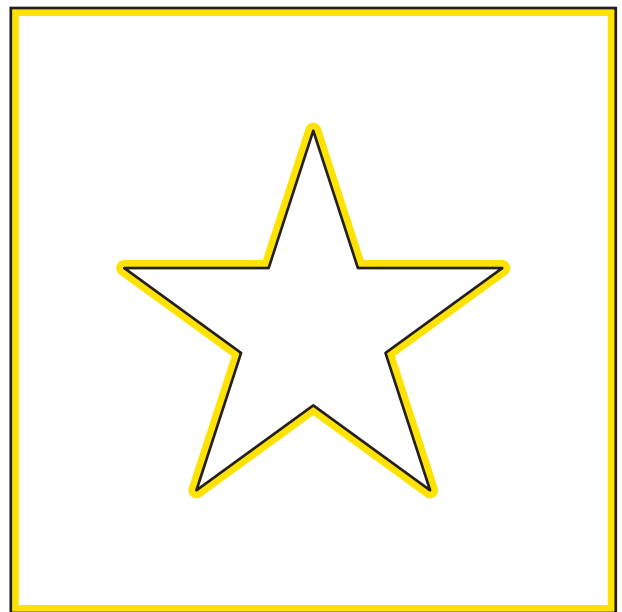
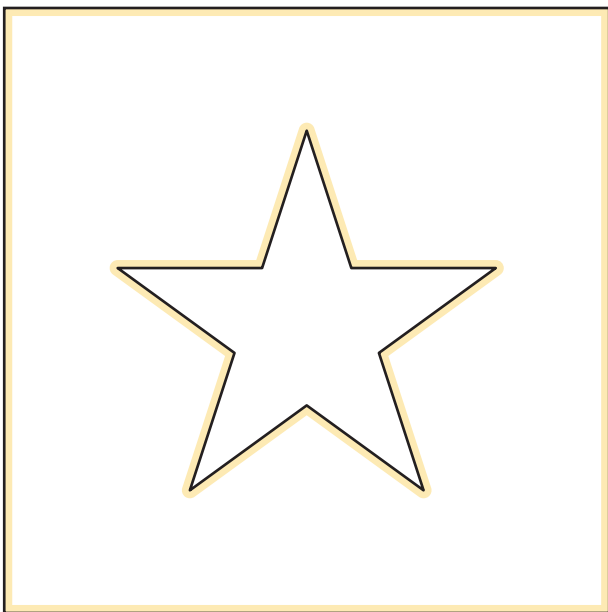
Doesn't this star appear to be pale yellow in color?
But in fact, it is a white star with a thin yellow line flanking its black outline.



Increasing the thickness of the black outline reduces the watercolor effect. Because of increased contrast, we cannot perceive the yellow line clearly.
Increasing the thickness of the yellow line also reduces the watercolor effect since our brain can now perceive it as a separate thicker line.



When the yellow and black lines are interchanged, the watercolor effect is reversed. Now, the yellow color appears to be spreading outwards.



Placing the same star within a black square with a yellow border flanked inside enhances the watercolor effect, additionally creating a 'key-hole'. The boundary defines a region and the hole appears to be 3 dimensional. Now the figure-ground perception is also reversed. The square with a star-shaped hole is perceived to be the figure in the front and the area inside the star is perceived as the ground at the back.

With the increase in the brightness of the yellow lines, a stronger key-hole can be observed.



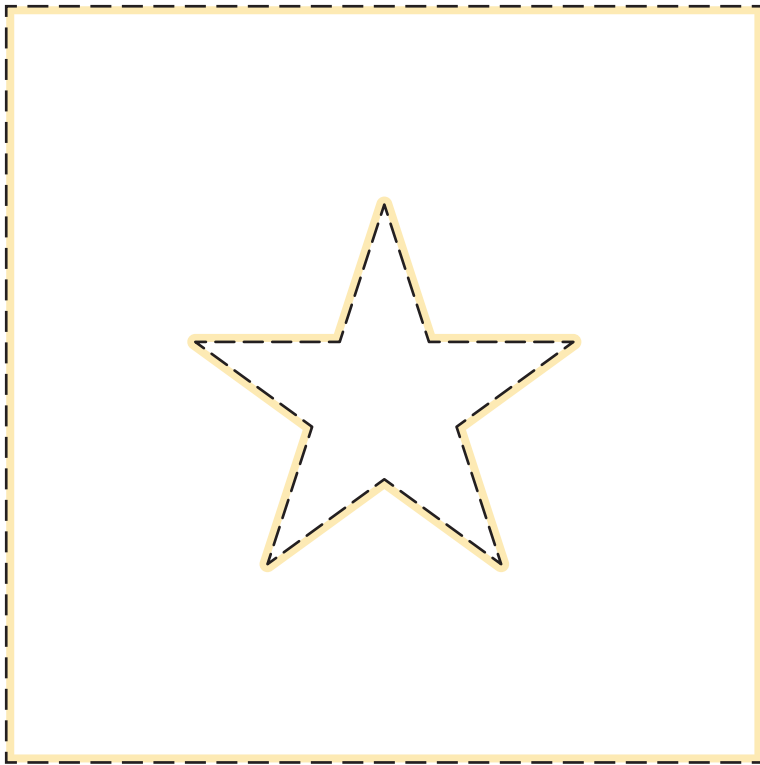
Even with multiple objects, the watercolor effect is retained. The area where the color spreads is perceived as the figure. The pale yellow square with multiple star-shaped holes can be seen at the front as the figure, with white-colored ground at the back.



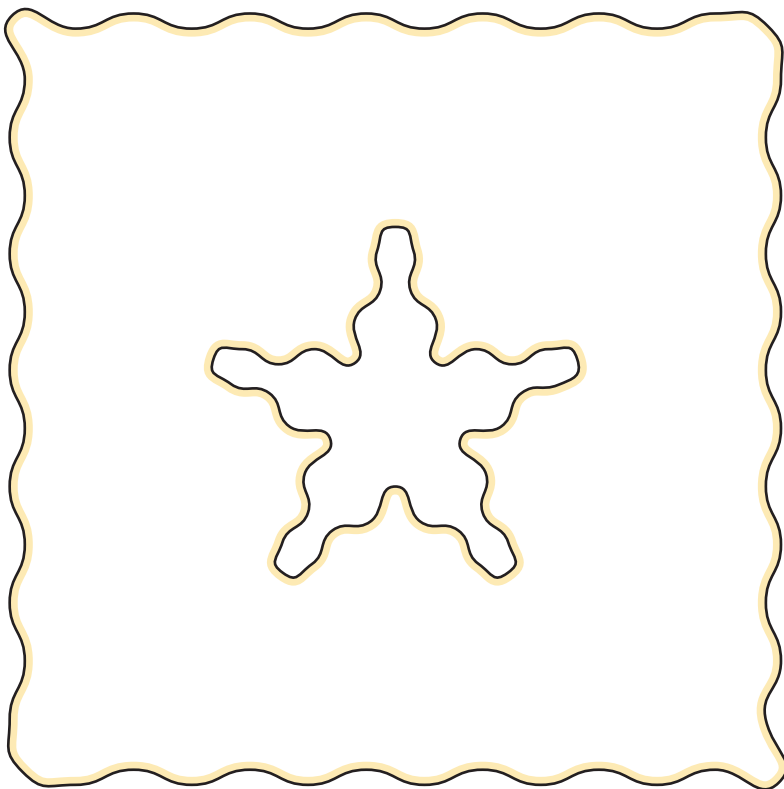
By increasing the thickness of the yellow line in the second row, a stronger key-hole can be observed, and increasing the thickness of the black outline in the third row weakens the effect.



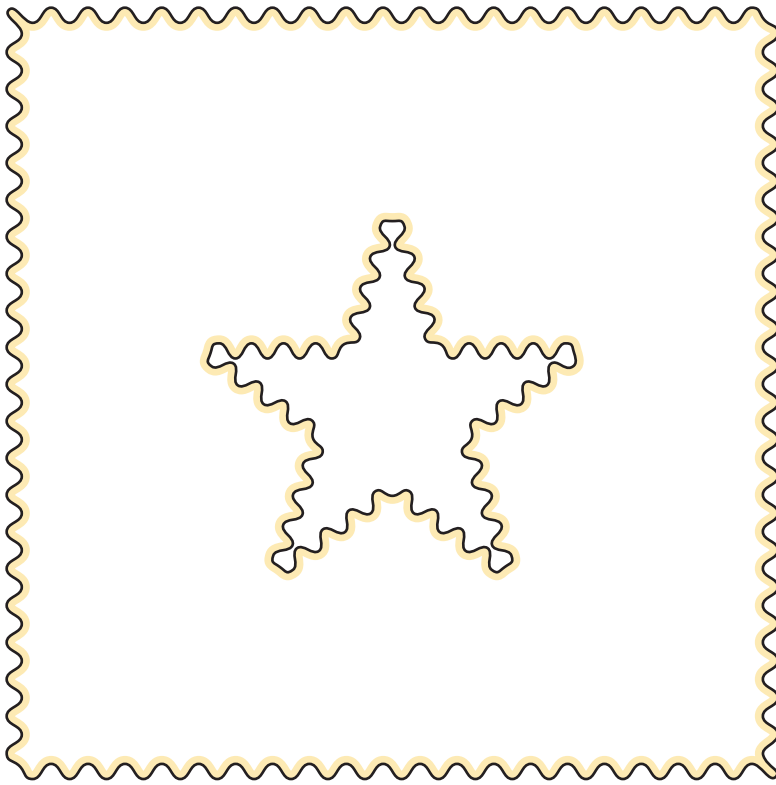
Removing the black outline completely removes the watercolor and the key-hole effect.



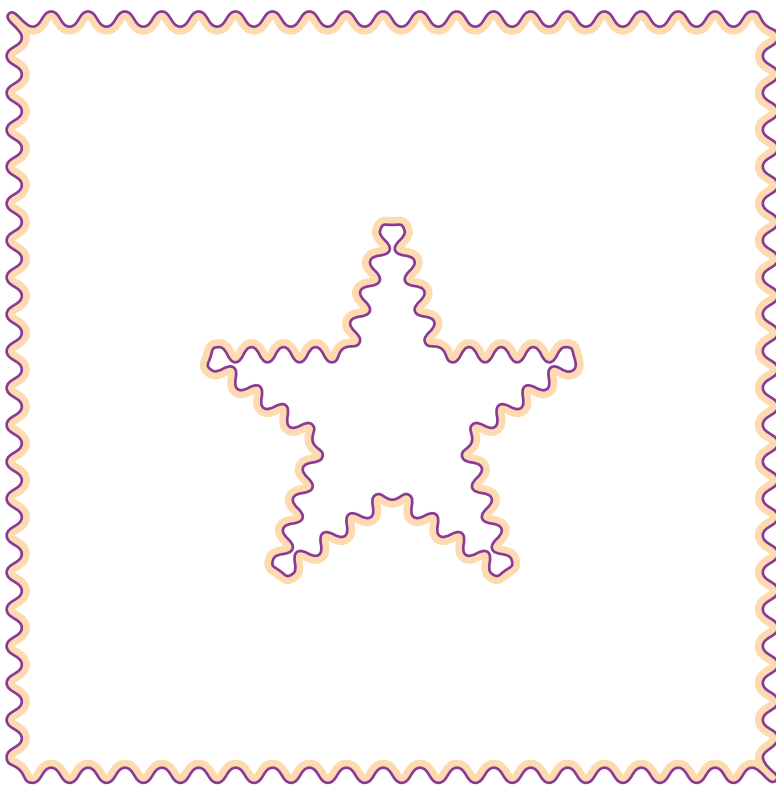
The watercolor effect persists even with dashed or dotted outlines, though the effect is not as pronounced.



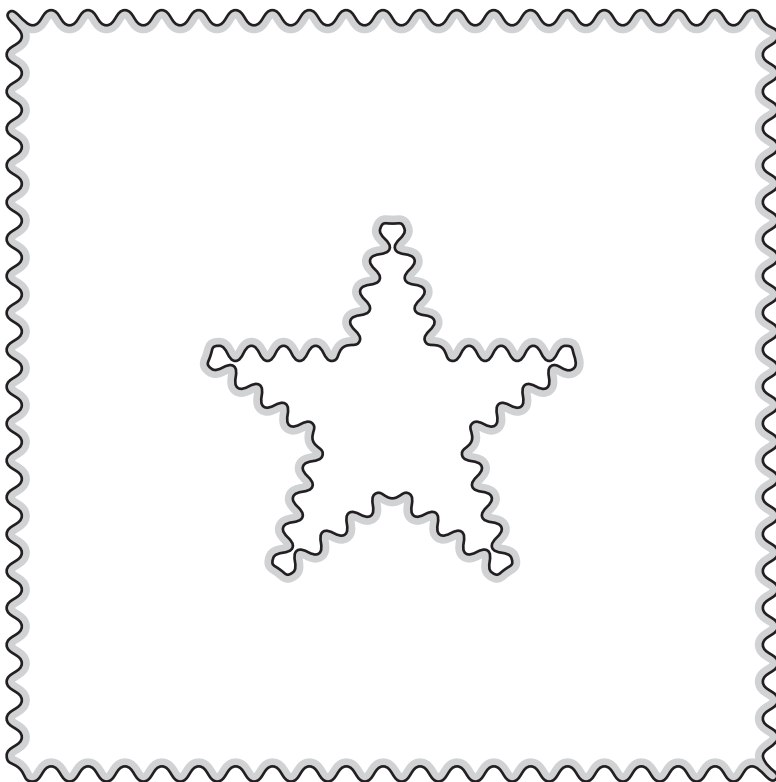
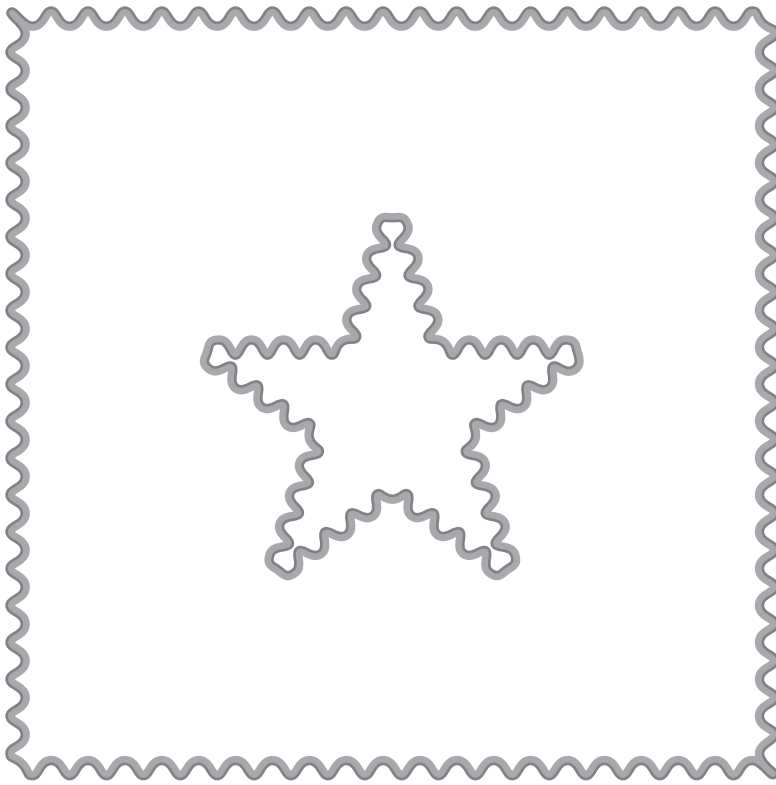
Wavy lines enhance the watercolor effect.



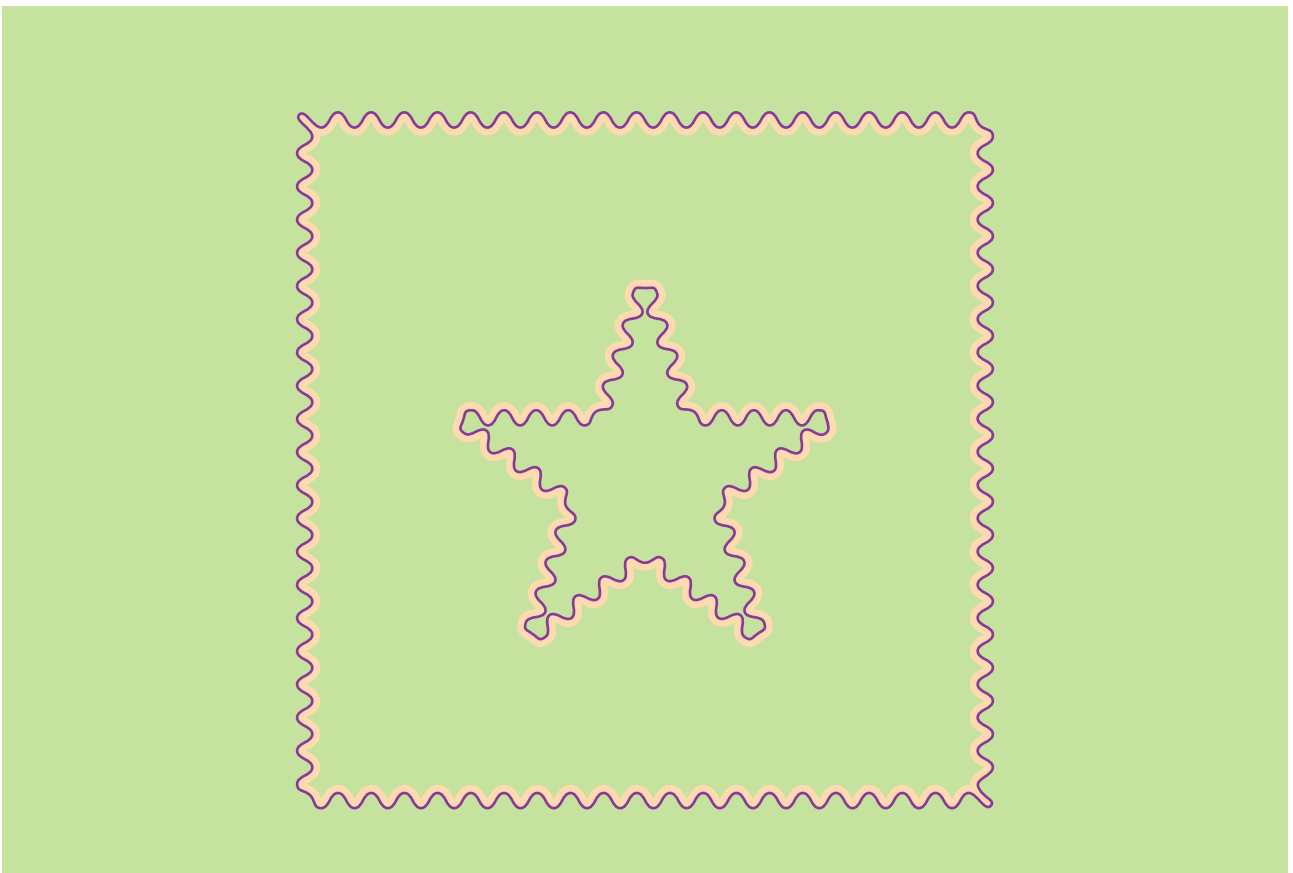
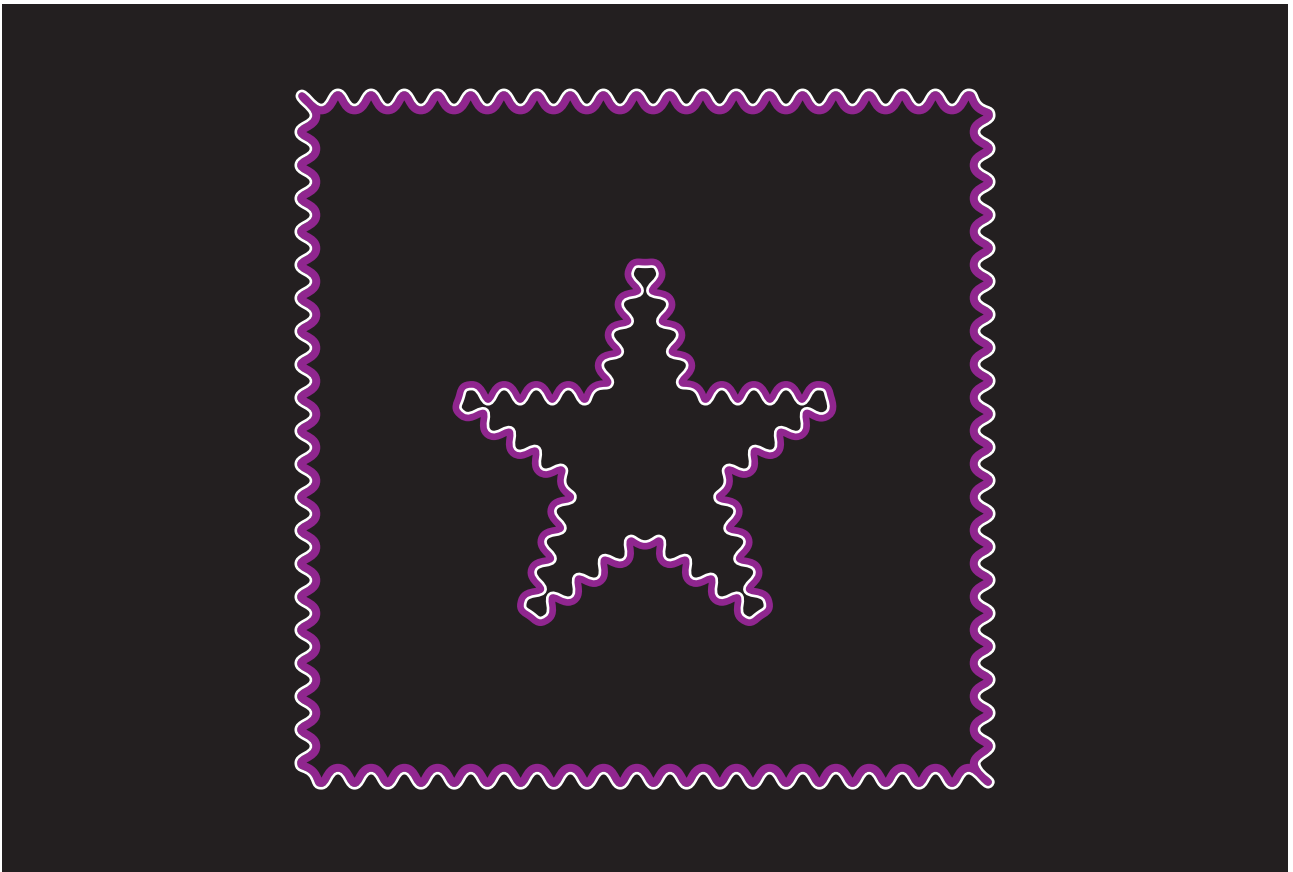
Increasing the waviness increases the watercolor effect. The spreading seems to be almost uniform.



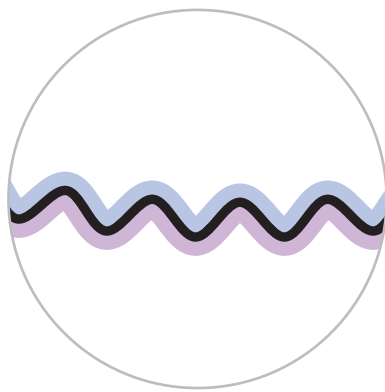
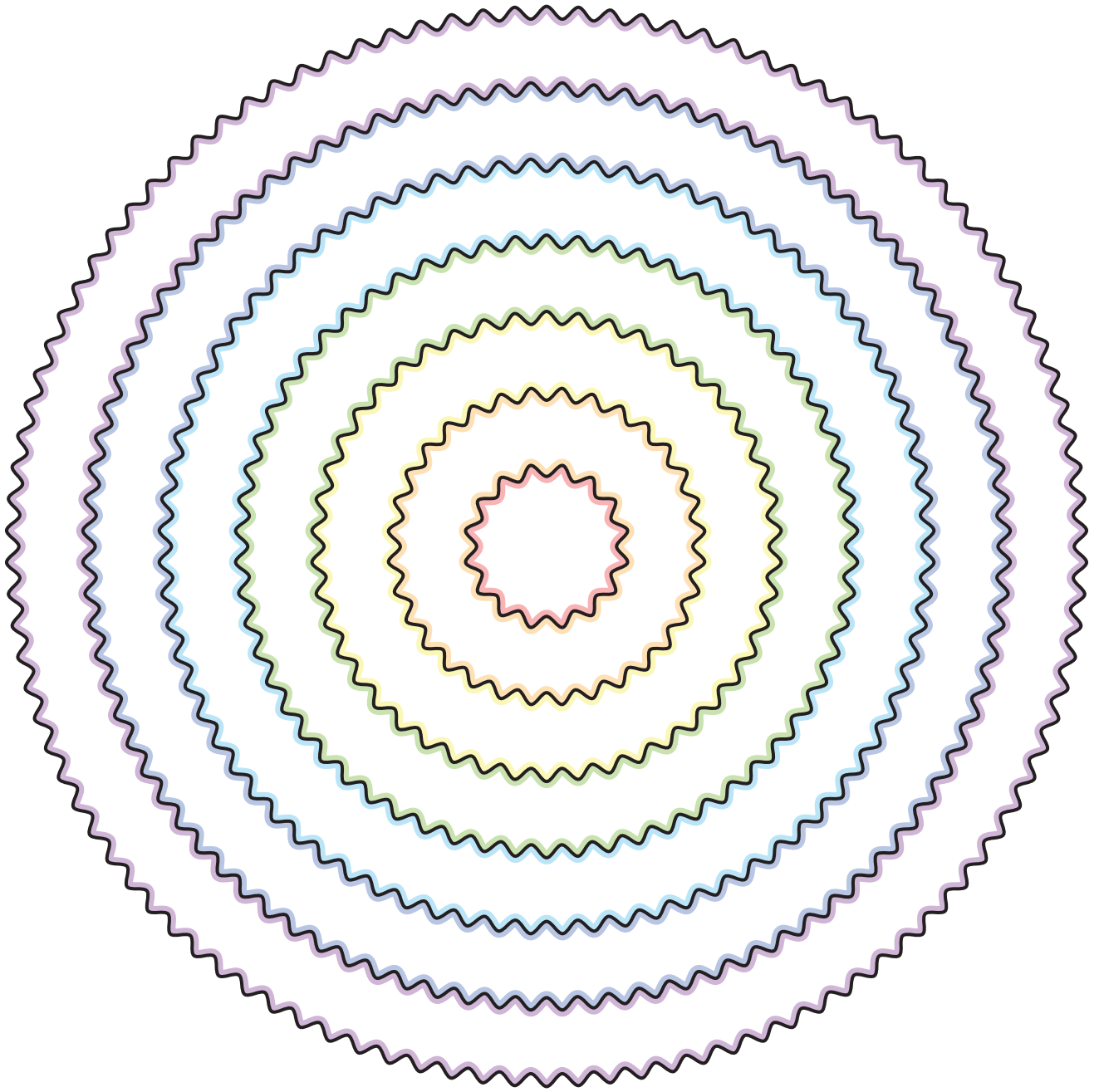
The color spreading occurs in any combination of dark and light-colored outlines.



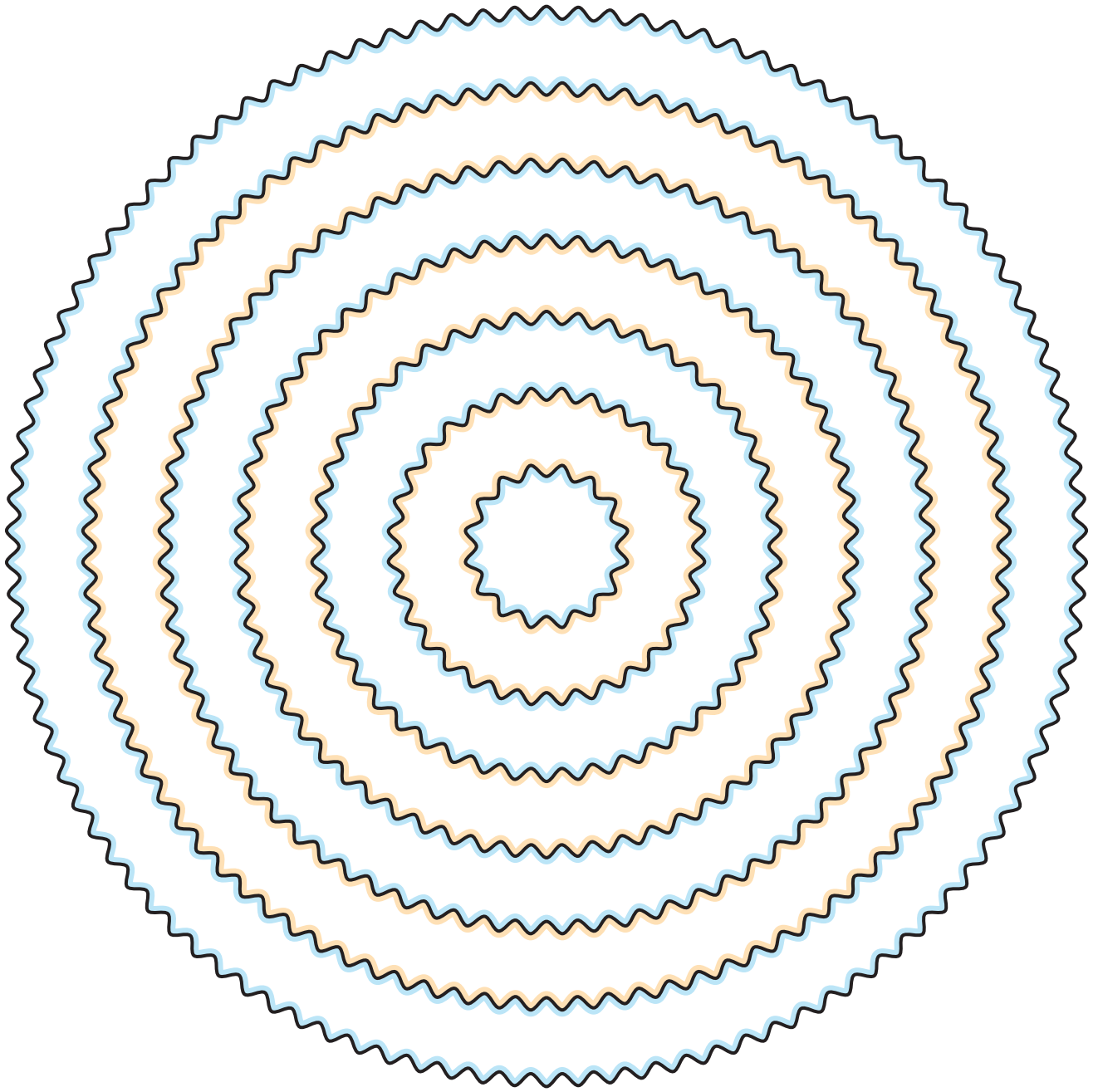
But, different shades of the same color may reduce the watercolor effect, since our brain tries to merge them and perceive them as a single outline. Higher the contrast between two colors, stronger is the watercolor illusion.



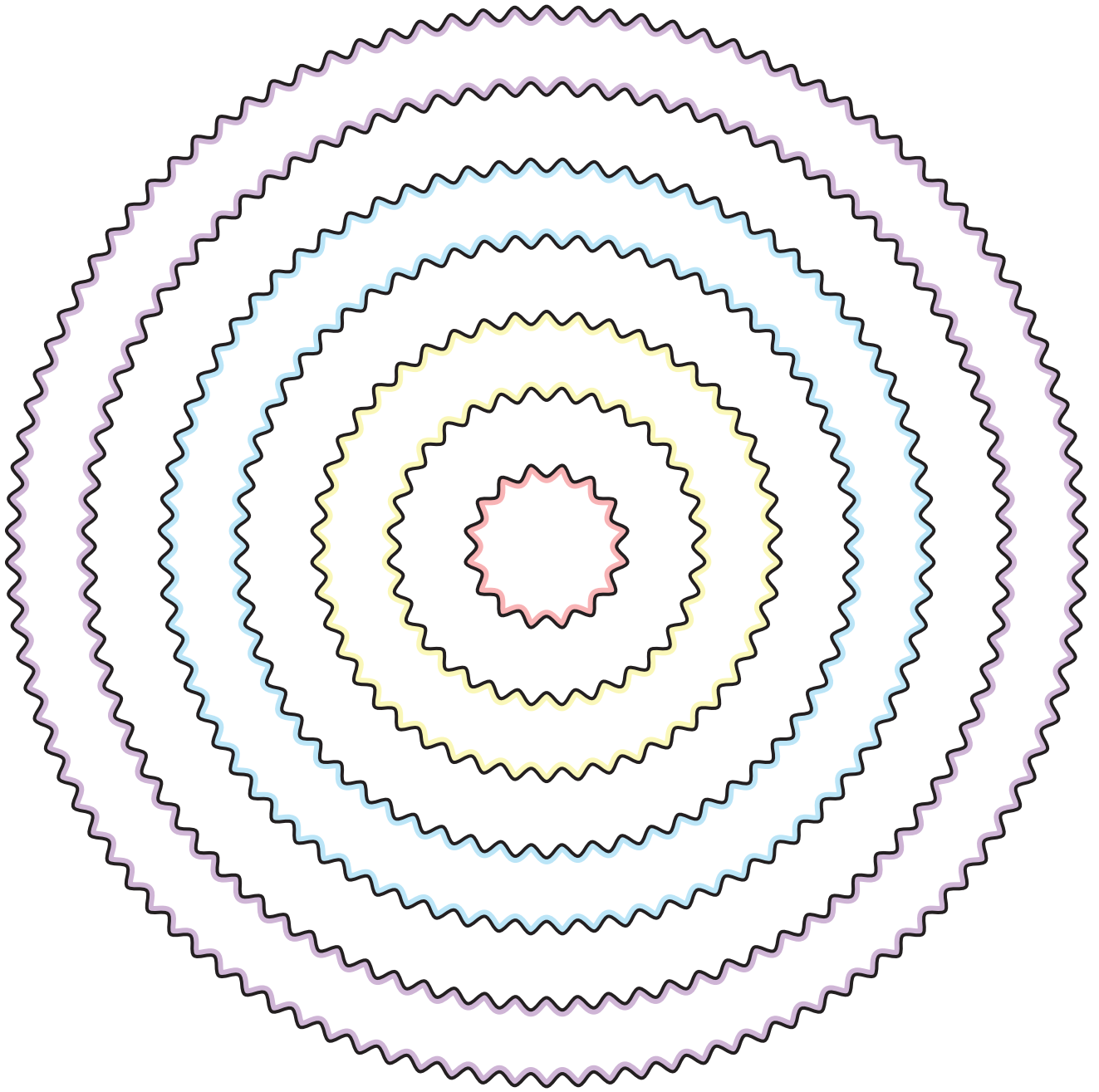
The effect occurs on different colored backgrounds too. The line with higher contrast to the background is perceived as the border and the line with lower contrast to the background appears to spread in.



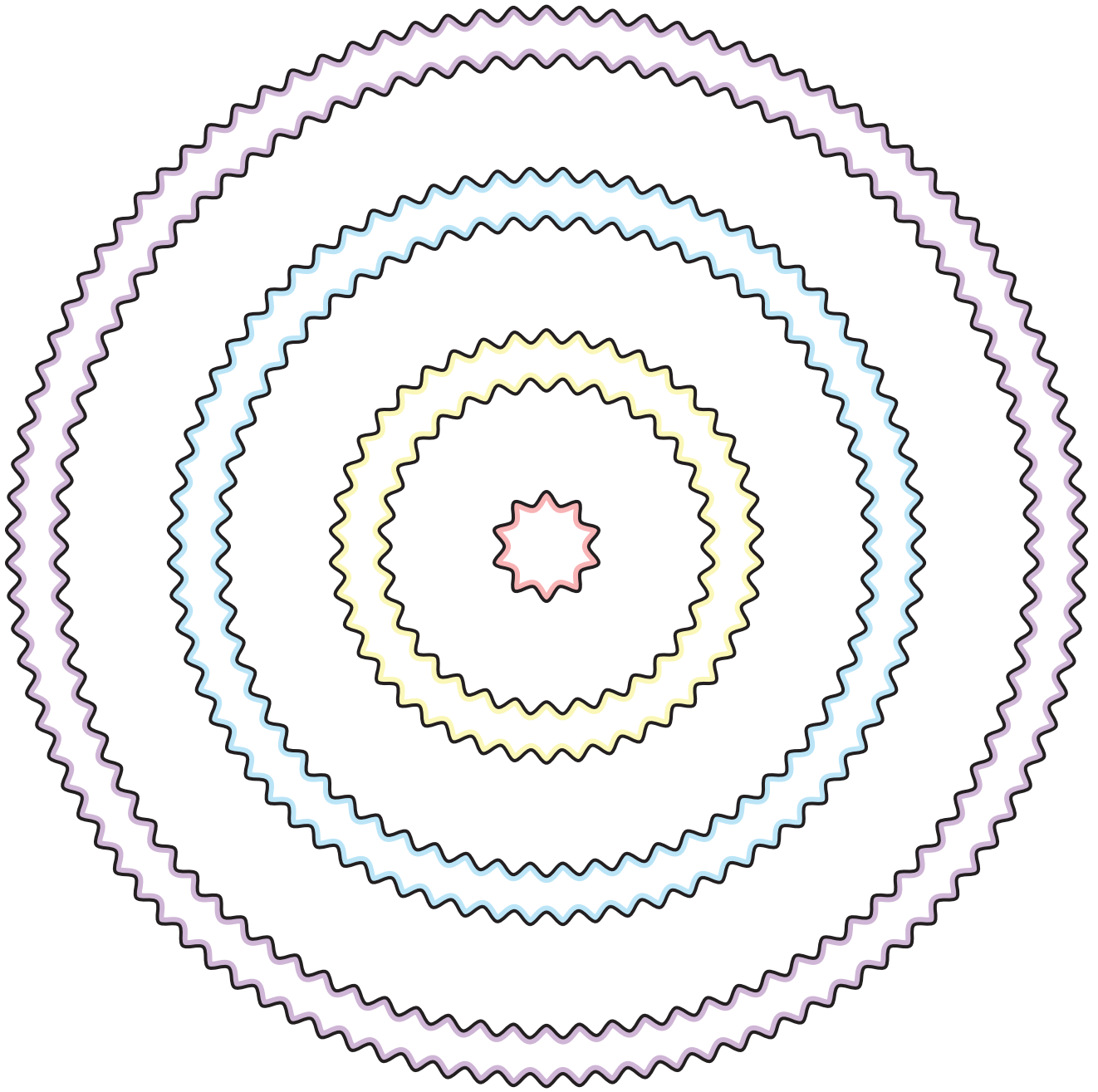
Here, because of 2 different colors flanking against the same black outline, the watercolor effect is very faint.



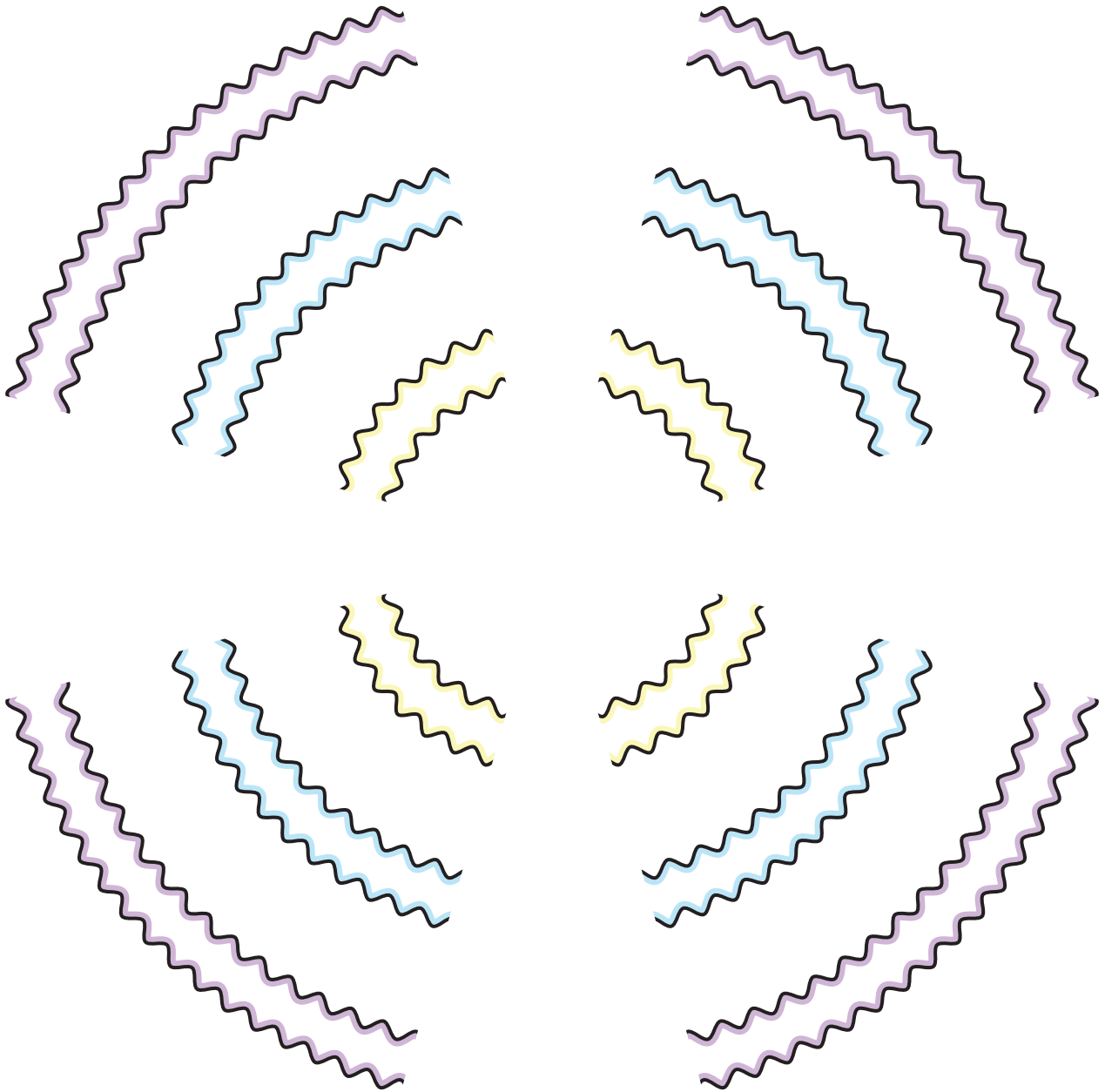
By using 2 contrasting colors against the same black outline, the watercolor effect is enhanced. Now they look like concentric circles of alternating blue and orange colors.



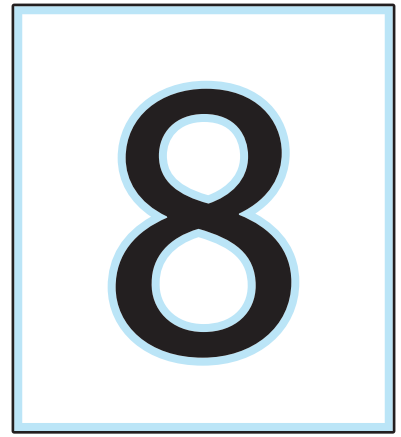
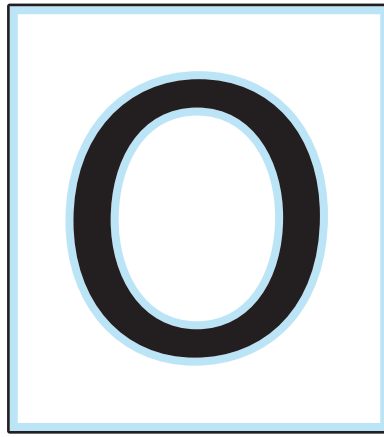
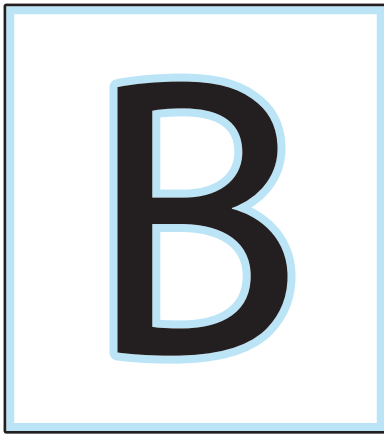
Flanking only one color against the black outline enhances the spreading.



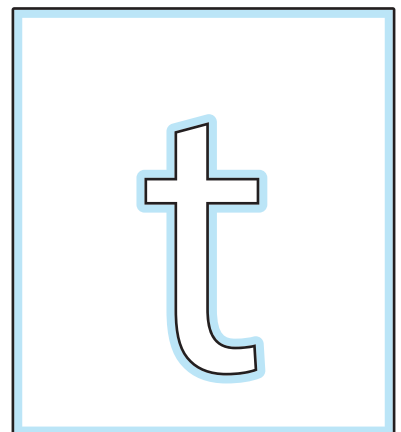
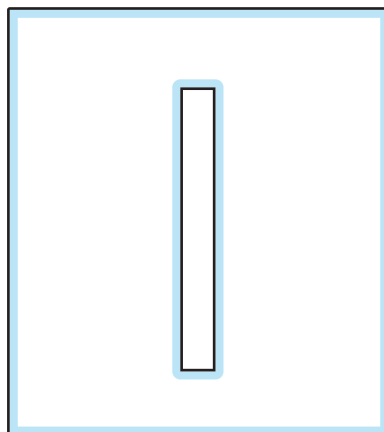
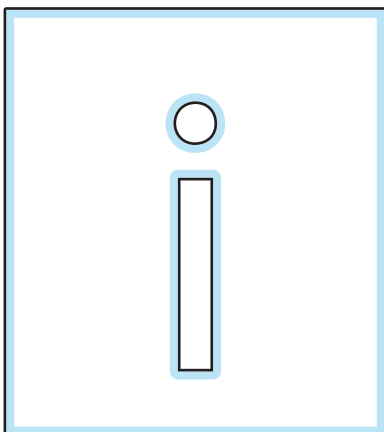
If the similar colored lines are closer to each other, the watercolor effect is stronger. It adds to Gestalt's law of proximity.



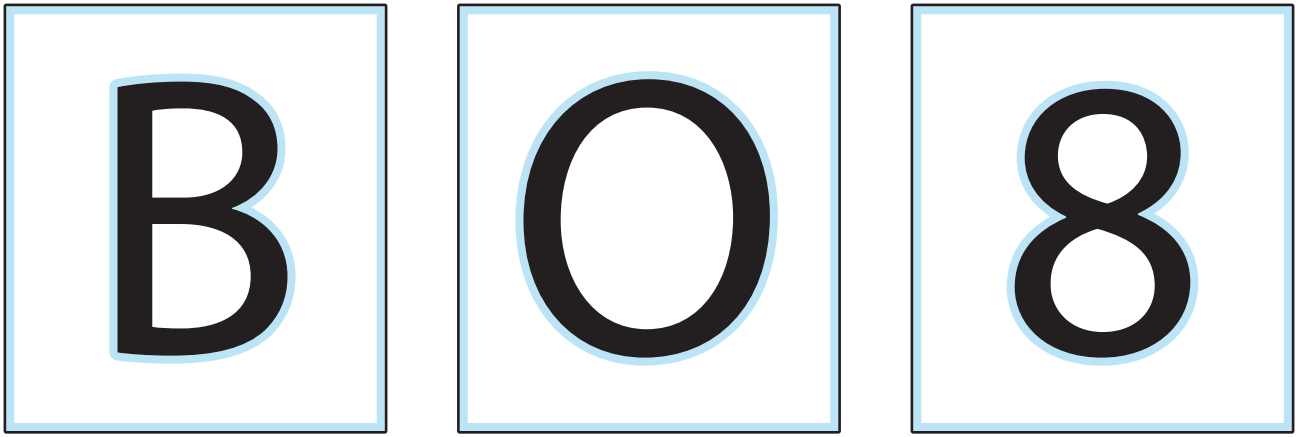
The watercolor effect still occurs even if the outline is not a closed loop. It enhances Gestalt's law of closure.



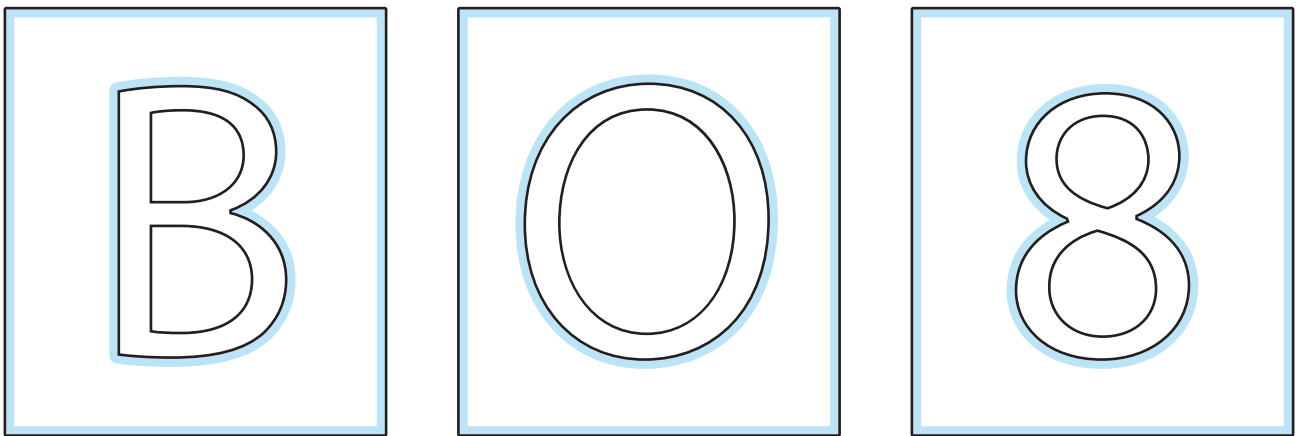
These letterforms inside the black borders with blue lines flanked against them also display the watercolor effect whether or not they have closed counters.



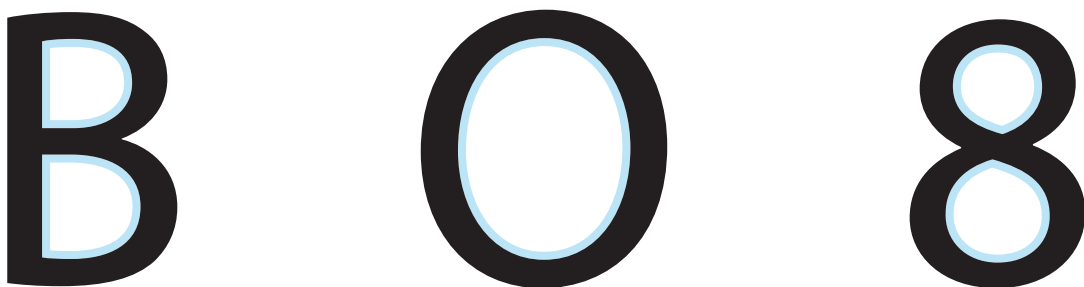
Using only the outlines of the letterforms creates a key-hole effect. Here, the rectangles with letter-shaped cutouts are perceived to be at the front as the figures.



For letterforms with closed counters, removing the inner flanking of the blue line causes the key-hole effect. But here, the letterforms are also perceived to be at the front as the figures along with the rectangles.



Using only the outlines of the letterforms also creates a key-hole effect. But here, it's not very clear whether the letterforms are part of the figure at the front or ground at the back.



Removing the outer flanking of the blue line along with the rectangle also creates the watercolor effect so that the letters appear to be filled with pale blue color.

How can watercolor illusion be used in design?

Maps:

To create subtly colored enclosed areas differentiating various regions.

Posters and other print media:

Watercolor illusion can be used in texts and illustrations to achieve the effect of an entire colored space with limited use of colors.

Digital rendering:

It can help to save rendering time by reducing the usage of colors.

References:

Bach, M. (2014, November 16). *Watercolor Illusion*. Michael Bach.

<https://michaelbach.de/ot/col-watercolor/>

Watercolor illusion. (2022, January 31). In *Wikipedia*.

[https://en.wikipedia.org/wiki/Watercolor_illusion#:~:text=The%20watercolor%20illusion%2C%20also%20referred,\(Figures%201%20and%202\).](https://en.wikipedia.org/wiki/Watercolor_illusion#:~:text=The%20watercolor%20illusion%2C%20also%20referred,(Figures%201%20and%202).)