The Effect of Heat and Chemicals on the Crazing of Eyeglass Lenses

Research Question

The purpose of this experiment was to determine the extent to which temperature affects the crazing of glass lenses. The independent variable is the heat or chemical stress the glasses are put under, and the dependent variable is the crazing of the lens.

Data Analysis

Temperature (C)	Measured Crazing	First Crazing
40	Inconclusive	Inconclusive
40	Inconclusive	Inconclusive
50	Inconclusive	Inconclusive
50	Inconclusive	Inconclusive
60	Inconclusive	Inconclusive
60	Inconclusive	Inconclusive

Procedures

Glasses were heated and cleaned with harsh chemicals. Results were measured using Apple ProRAW and ImageJ.

Conclusions

- Lens crazing is uncommon and requires extreme cases of heat or chemicals.
- It's unlikely for glasses to craze in a short period of time of not being used.
- Extreme temperature drops will not craze lenses.

Coatings

The Importance

Coatings are necessary to prevent hinderances such as fog or reflections in eyesight[1]. A study showed that glasses coated with anti-fogged polymer coating fogged 55% of the time, while non-coated glasses fogged 81% of the time[4].

The Problem

Almost every case of glasses crazing is caused by faulty coatings. They often expand and contract at different rates than the glass under heat, which can lead to cracks. They also could be worn down over time by harsh cleaning chemicals.[5]

Photo credit: https://goldeneyeoptometry.com/2024/02/19/anti-reflective-coating-see-better-and-look-better/

Lens Crazing

Glasses crazing is when a coating on the lens of the glasses, often anti-reflective, forms spiderweb-like cracks. This creates a cloudy or blurry effect and can hinder eyesight.

Photo credit:
Tommy Victory
https://www.carfia.com/blogs/our-stories/how-can-i-prevent-crazing-on-my-eye-glasses
https://stock.adobe.com/search?k=sky+sun

Research Question

The purpose of this experiment was to determine the extent to which temperature affects the crazing of glass lenses.

Hypothesis

Hypothesis: Increased temperature will increase the crazing of glass lenses
Null Hypothesis: Temperature will not affect the crazing of glass lenses.

The Importance

Independent Variable: Different temperatures and different cleaning practices
Dependent Variable: Measured crazing of glass lenses.

Procedures

1

A hairdryer was used as a heat source to heat the lenses, and 91% isopropyl alcohol was used as a harsh cleaner.

2

One set of glasses were set aside as a control pair.

3

Glasses were heated to temperatures 40 C, 50 C, and 60 C using the hairdryer. The hairdryer was allowed to come to temperature before the glasses were introduced.

Photo credit:
Tommy Victory
https://www.amazon.com/Conair-1875-Turbo-Dryer-Black/dp/B00005O0MZ?th=1
https://www.walgreens.com/store/c/walgreens-91-isopropyl-alcohol/ID=300400127-product

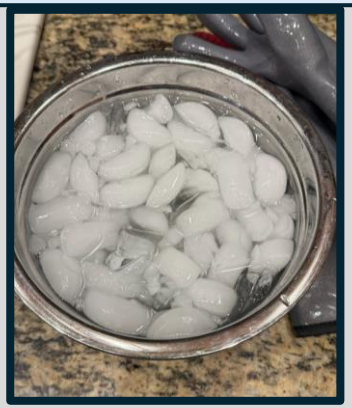
Procedures

4

One pair of glasses was wiped with 91% isopropyl alcohol to measure the effect of harsh cleaning products.

5

One pair of glasses was heated to 80 C before being put in an ice bath to measure the effect of rapid temperature change.



6

Photos were taking using Apple ProRAW, and crazing was measured using ImageJ.

Photo credit:
Tommy Victory
https://www.walgreens.com/store/c/walgreens-91-isopropyl-alcohol/ID=300400127-product
https://imagej.net/imagej-wiki-static/Welcome

Results

Temperature (C)	Measured Crazing	First Crazing
40	Inconclusive	Inconclusive
40	Inconclusive	Inconclusive
50	Inconclusive	Inconclusive
50	Inconclusive	Inconclusive
60	Inconclusive	Inconclusive
60	Inconclusive	Inconclusive

Results from the first round of testing were inconclusive. This is either because the glasses had the incorrect coating, or the heat was not high enough to craze the lenses. The testing will be redone with a better heating element such as a water bath, and if that does not work, will try different pairs of glasses or different methods of achieving crazing.

Results

Method	Measured Crazing
Heated by air gun to 80 C	No
Heated by water bath to 80 C	No
Heated to 80 C with water bath then cooled to ~8 C in ice bath	No
Wiped with 91% isopropyl alcohol	No

Results from the second round of testing showed that glasses lens crazing is difficult to achieve. More extreme forms of change in temperature and harsh chemicals were used to attempt to get crazing, but each method failed. The idea with the ice bath was to rapidly change the temperature of the glasses so the coating would expand and contract at a different rate then the lens, and the idea with the alcohol is that harsh chemicals can damage anti-reflective coating.

Discussion of Results

Claim

The risk of glass lenses crazing is very low. It would take multiple hours of heating at high temperatures to achieve crazing on most glasses.

Evidence

Glasses heated at temperatures up to 80 degrees Celsius did not craze. Glasses put through extreme temperature drops in an ice bath did not craze. Glasses cleaned with 91% isopropyl alcohol before being heated did not craze.

Reasoning

80 degrees Celsius is a very high temperature, so no crazing shows that many glasses are very heat-resistant. The methods used in this experiment target the causes of crazing, but no crazing was produced.

Errors

Errors

- The heating of the hair dryer was inconsistent.
- The glasses got a lot of fingerprints on them.
- The hairdryer kept blowing away the thermometer, which made it difficult to measure the temperature.

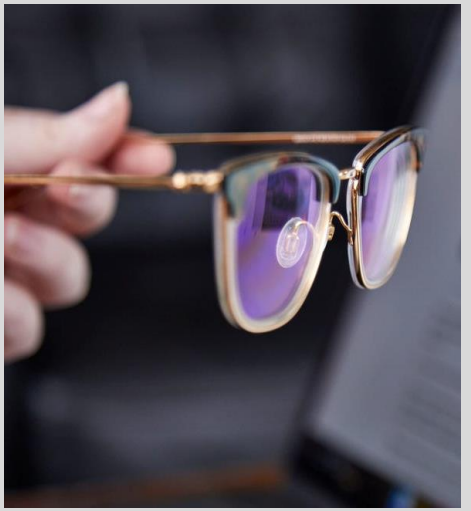
Effects

- The inconsistent heating of the hair dryer could affect the temperature in the glasses, which could have reduced the chance of crazing
- The fingerprints made it harder to measure crazing, but microfiber cloths were used to clean them

Next Steps

Future Experiments

- Heating glasses over long periods of time.
- Testing the performance of different coatings such as anti-fog.
- Testing different types of lenses like blue light or readers.



Applications

- Preventing glasses crazing saves money on repairs or new glasses.
- Hindered eyesight could be dangerous to elderly or some professions.

Photo credit:
https://www.popularmechanics.com/technology/gear/a29535060/blue-light-glasses/

References Cited

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