



Expertise fine-tunes mental representations of targets during challenging visual search

Michael C. Hout¹, Alexis Lopez¹, Arryn Robbins¹, & Megan H. Papesch²

1 – New Mexico State University; 2 – Louisiana State University

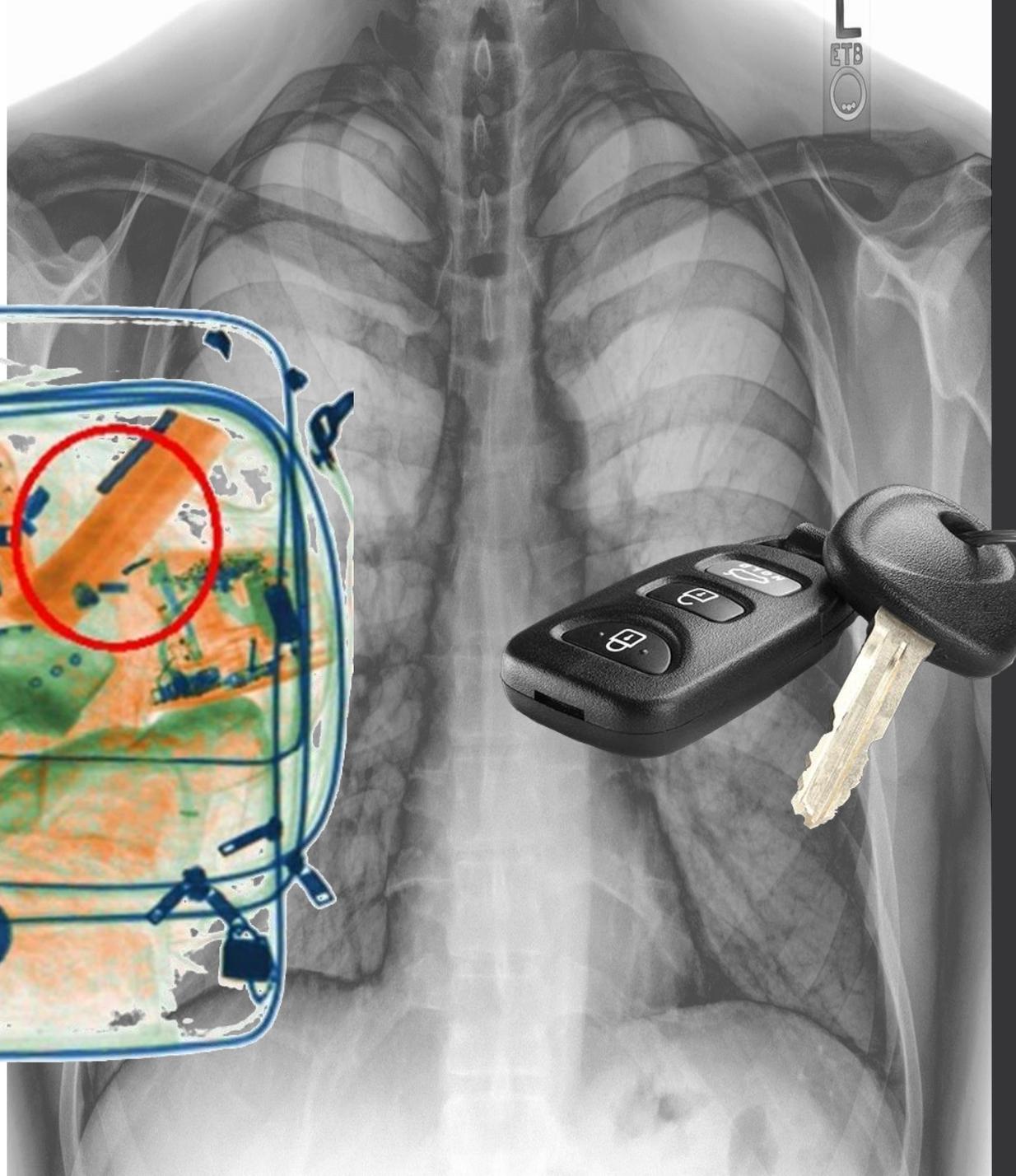
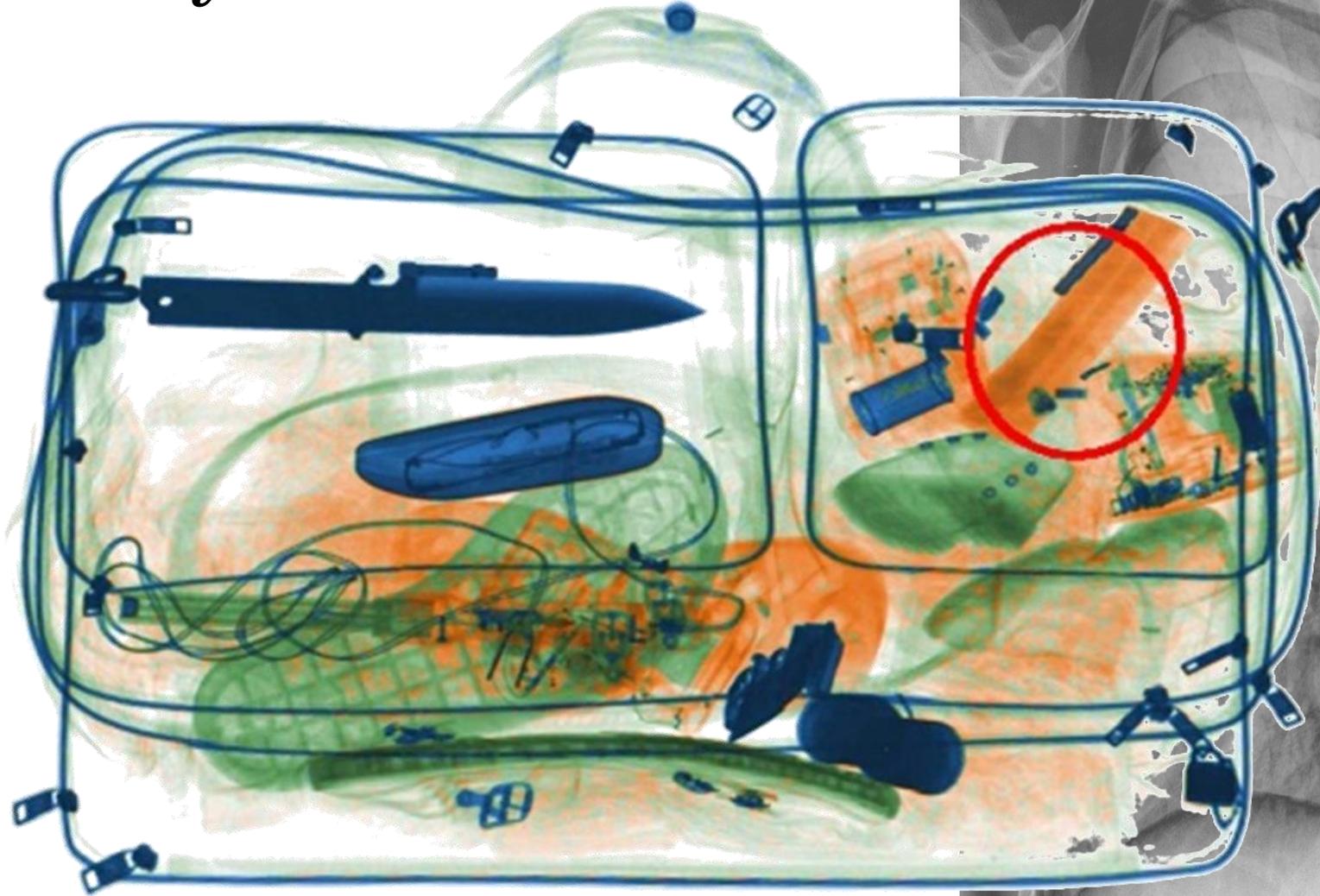


Expertise



Acquired knowledge and skills are often hard to articulate.

When visual search really matters



Relatively little has been done to quantify what makes professionals different from novices.

Research article

Assessing visual search performance differences between Transportation Security Administration Officers and nonprofessional visual searchers

Adam T. Biggs, Matthew S. Cain, Kait Clark, Elise F. Darling & Stephen R. Mitroff

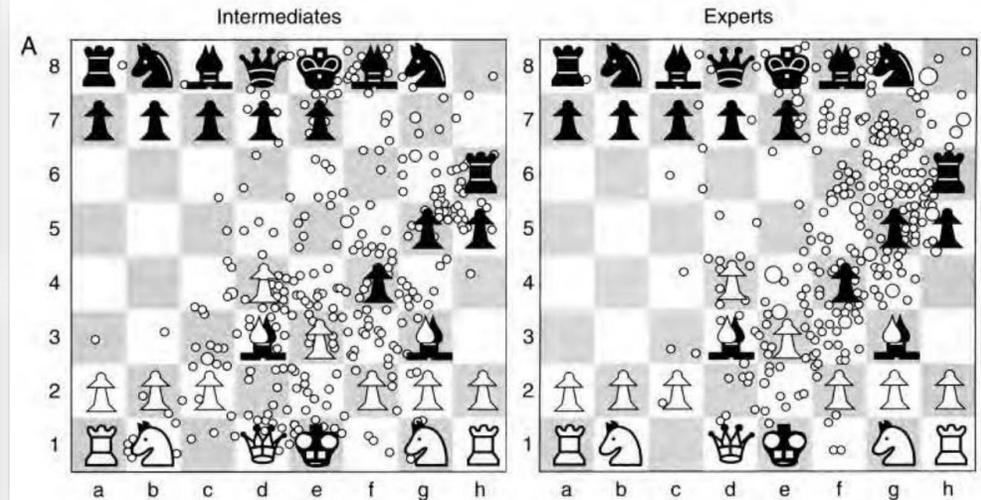
Pages 330-352 | Received 08 Mar 2013, Accepted 22 Mar 2013, Published online: 13 May 2013

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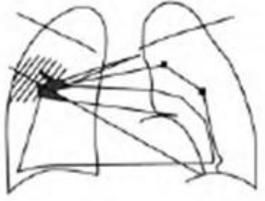
Article | August 2013

Scanners and drillers: Characterizing expert visual search through volumetric images

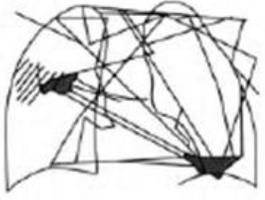
Trafton Drew; Melissa Le-Hoa Vo; Alex Olwal; Francine Jacobson; Steven E. Seltzer; Jeremy M. Wolfe



Radiologist



Resident



3rd year medical student



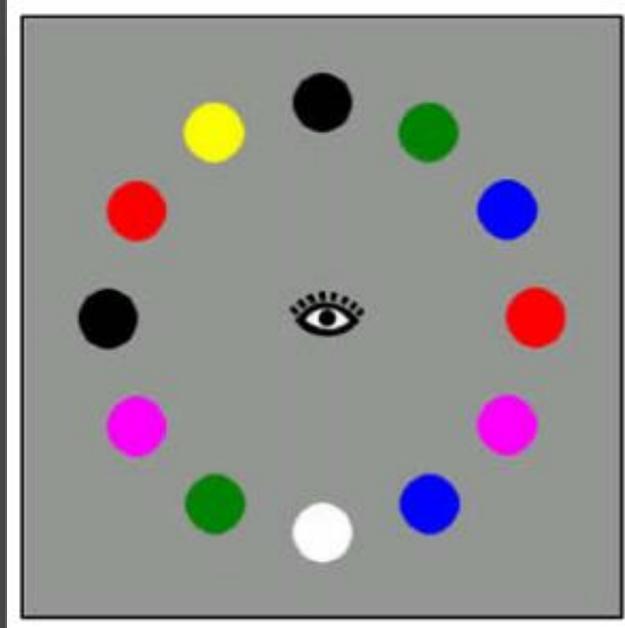
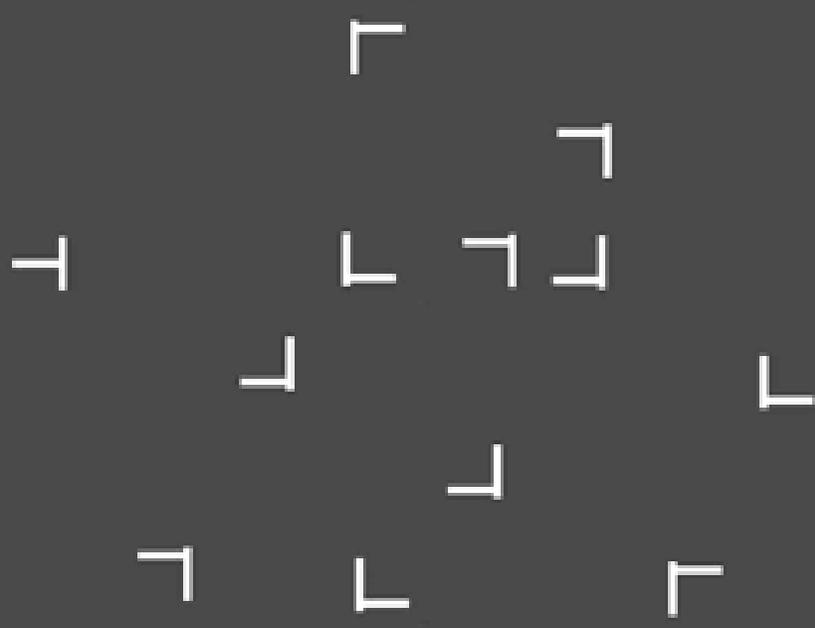
2nd year medical student



1st year medical student



To develop efficient training requires a fundamental understanding of the underlying cognitive processes – and oculomotor behaviors – that are affected during the acquisition of expertise.



Finding things in the lab:
1) Simple stimuli isolate basic features.
2) Single targets simplify the mental “template.”
3) Single exposure eliminates memorial influence.

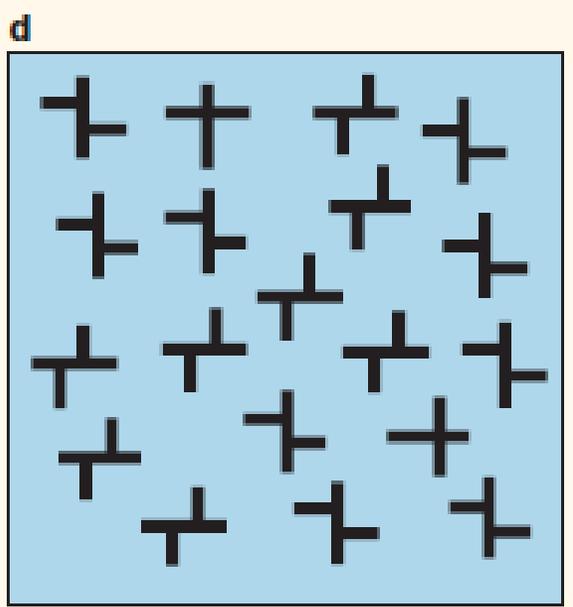
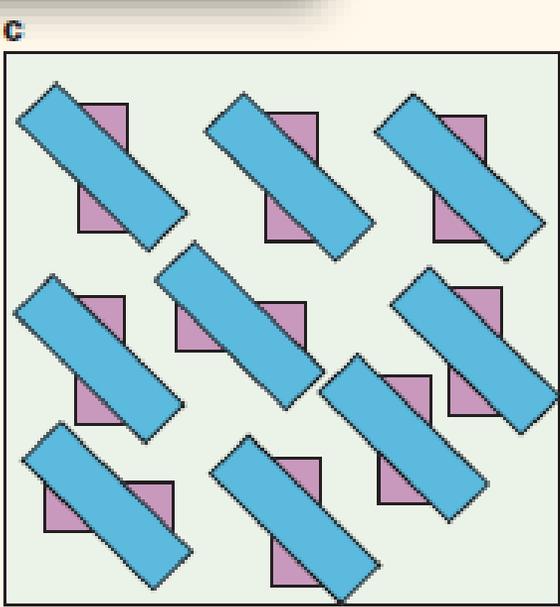
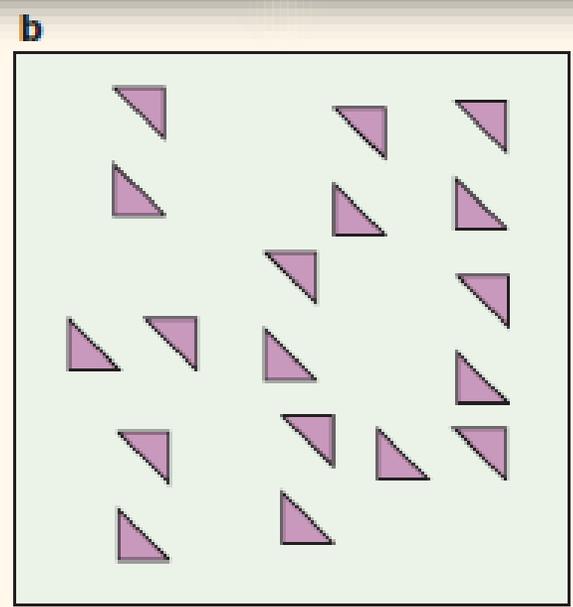
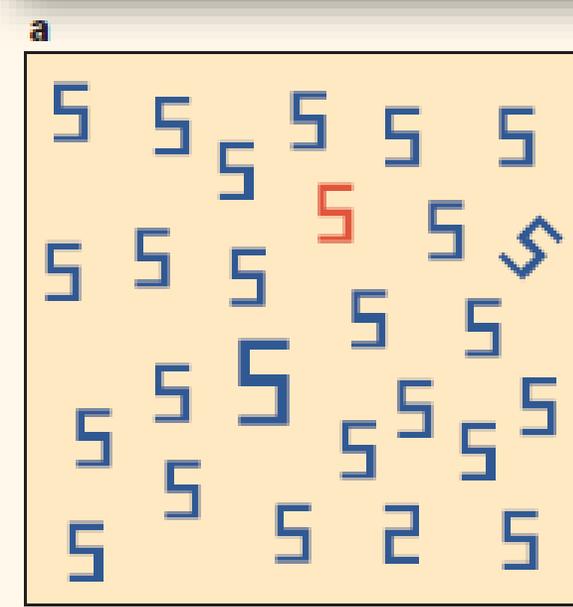


Figure 1 | **Easy and difficult examples of visual search.** **a** | It is easy to find the red, tilted or big '5'. It is not easy to find the '2' among the '5's'. **b,c** | It is difficult to find the horizontal pairs of triangles in **b**, but in **c** it is easy because the early visual system can use intersection information to infer that the blue items occlude pink rectangles. **d** | In this panel, search for the 'plus' is inefficient because the intersection information here does not guide attention.



Finding things in everyday life: 1) Visual scenes can be cluttered and complicated. 2) We often search for multiple targets. 3) Search is often repeated in the same context.

Challenges faced by TSA screeners: 1) Imprecise definition of “weapons.” 2) Must look for many things at once. 3) Targets show up with varying frequency.

	Carry-On
Aerosols Aerosols are prohibited with the exception of personal care items or toiletries in limited quantities.	⊘
Blasting Caps	✗
Chlorine for Pools and Spas	✗
Dynamite	✗
Electronic Cigarettes and Vaping Devices The FAA prohibits these devices in checked baggage. Battery-powered E-cigarettes, vaporizers, vape pens, atomizers, and electronic nicotine delivery systems may only be carried in the aircraft cabin (in carry-on baggage or on your person). Check with your airline for additional restrictions. Remove all electronic cigarette and vaping devices from carry-on bags if checked at the gate or planeside.	✓
Fire Extinguishers and Other Compressed Gas Cylinders	✗
Fireworks	✗
Flammable Liquid, Gel, or Aerosol Paint	✗
Flammable Paints	✗
Fuels Cooking fuels and any flammable liquid fuel is prohibited.	✗
Gas Torches	✗
Gasoline	✗
Gel-Type Candles	✗
Hand Grenades	✗
Lighter Fluid	✗
Lighters Lighters without fuel are permitted in checked baggage. Lighters with fuel are prohibited in checked baggage, unless they adhere to the Department of Transportation exemption, which allows up to two fueled lighters if properly enclosed in a DOT approved case.	✓
Liquid Bleach	✗
Non-Flammable Liquid, Gel, or Aerosol More than 3.4 oz./100 ml.	✓
Non-Flammable Liquid, Gel, or Aerosol More than 3.4 oz./100 ml.	✗
Realistic Replicas of Explosives	✗
Realistic Replicas of Incendiaries	✗
Recreational Oxygen Non-medically required, flavored or canned oxygen containers are prohibited.	✗
Safety Matches One book of safety (non-strike anywhere) matches are permitted as carry-on items, but all matches are prohibited in checked baggage.	✓
Small Compressed Gas Cartridges Up to two in life vests and two spares. The spares must accompany the personal flotation device and presented as one unit.	✓
Spillable Batteries Except those in wheelchairs.	✗
Spray Paint	✗
Strike-anywhere Matches	✗
Tear Gas Self-defense sprays containing more than 2% by mass of Tear Gas are prohibited in both carry-on and checked baggage.	✗
Torch Lighters Torch lighters create a thin, needle-like flame that is hotter (reaching 2,500 °F) and more intense than those from common lighters. Torch lighters are often used for pipes and cigars, and maintain a consistent stream of air-propelled fire regardless of the angle at which it is held.	✗
Turpentine and Paint Thinner	✗
Vehicle Airbags	✗

	Carry-On
Ammunition Check with your airline if ammunition is permitted in checked baggage. Small arms ammunition for personal use must be securely packed in fiber, wood or metal boxes or other packaging specifically designed to carry small amounts of ammunition. Ask about limitations or fees.	✗
BB Guns	✗
Compressed Air Guns Including paintball markers, may be carried in checked baggage without compressed air cylinder attached.	✗
Firearms Firearms carried as checked baggage MUST be unloaded, packed in a locked hard-sided container, and declared to the airline at check-in. Read the guidelines.	✗
Flare Guns Flare Guns may be carried as checked baggage MUST be unloaded, packed in a locked hard-sided container, within hazardous material regulations, and declared to the airline at check-in.	✗
Flares	✗
Gun Lighters	✗
Gun Powder Including black powder and percussion caps.	✗
Parts of Guns and Firearms Firearm parts, including magazines, clips, bolts and firing pins, are prohibited in carry-on, but may be transported in checked baggage.	✗
Pellet Guns	✗
Realistic Replicas of Firearms	✗
Starter Pistols Can only be carried as checked baggage and MUST be unloaded, packed in a locked hard-sided container, and declared to the airline at check-in.	✗

	Carry-On
Alcohol	⊘
Creamy Dips and Spreads	⊘
Fresh Whole Fruits	✓
Gravy	⊘
Jam and Jelly	⊘
Maple Syrup	⊘
Oils and Vinegars	⊘
Pies and Cakes	✓
Salad Dressing	⊘
Salsa and Sauces	⊘
Soups	⊘
Yogurt	⊘

	Carry-On
Box Cutters	✗
Disposable Razor	✓
Ice Axes/Ice Picks	✗
Knives Except for plastic or round bladed butter knives.	✗
Meat Cleavers	✗
Razor-Type Blades Box cutters, razor blades not in a cartridge are prohibited in carry-on.	✗
Sabers	✗
Safety Razor With Blades (allowed without blade)	✗
Scissors Metal with pointed tips and a blade length greater than four inches measured from the fulcrum are not allowed.	✗
Swords Cutting or thrusting weapons, including fencing foils.	✗

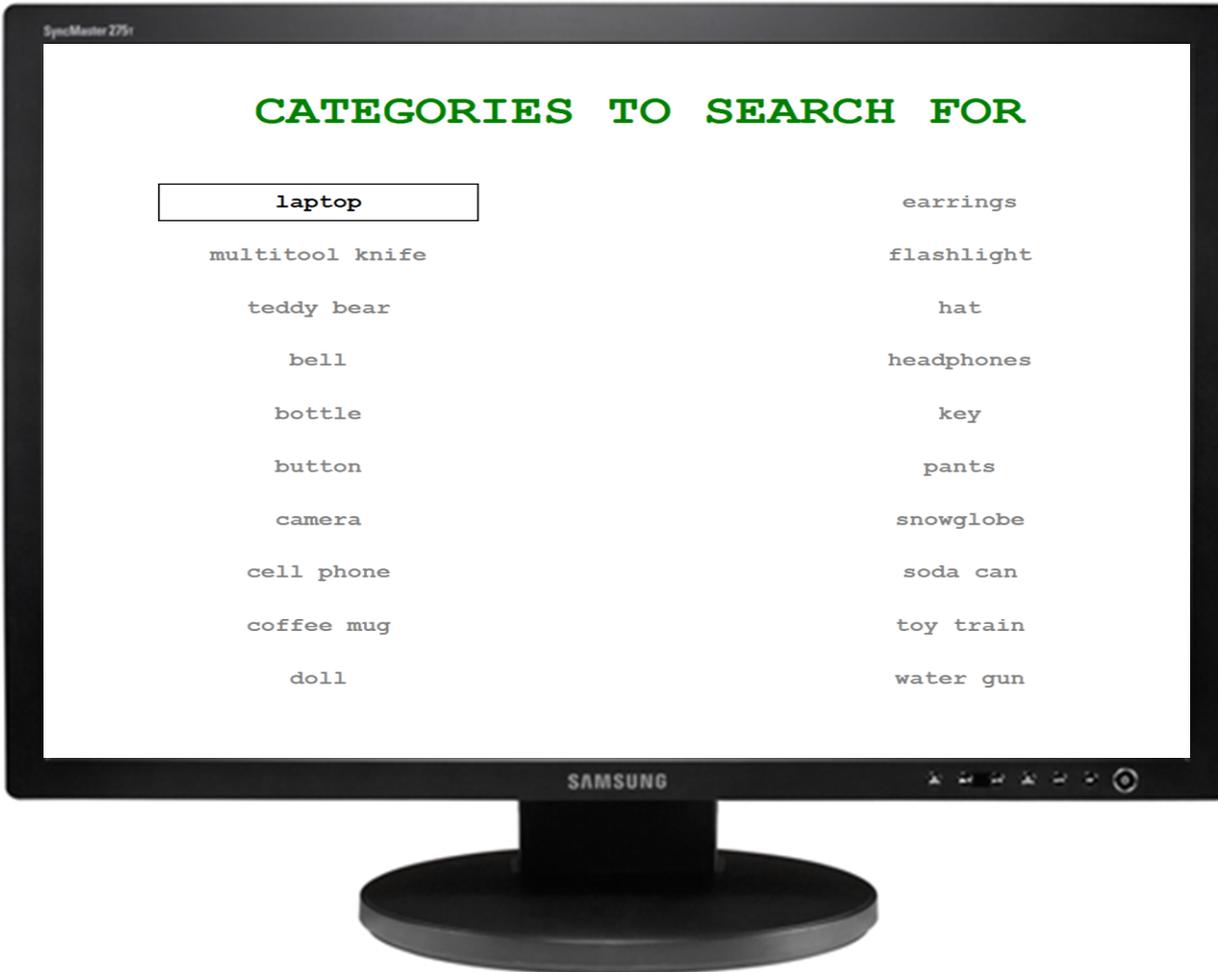
	Carry-On
Billy Clubs	✗
Black Jacks	✗
Brass Knuckles	✗
Kubatoos	✗
Martial Arts Weapons	✗
Night Sticks	✗
Nunchucks	✗
Self Defense Sprays One 4 fl. oz. (118 ml) container of mace or pepper spray is permitted in checked baggage provided it is equipped with a safety mechanism to prevent accidental discharge. Self-defense sprays containing more than 2 percent by mass of tear gas (CS or CN) are prohibited in checked baggage. For more information, visit faa.gov	✗
Stun Guns/Shocking Devices	✗
Throwing Stars	✗

	Carry-On
Axes and Hatchets	✗
Cattle Prods	✗
Crowbars	✗
Drills and Drill Bits Including cordless portable power drills.	✗
Hammers	✗
Saws Including cordless portable power saws.	✗
Screwdrivers/Wrenches/Pliers Less than seven inches in length.	✓
Tools Greater than seven inches in length.	✗

	Carry-On
Baseball Bats	✗
Bows and Arrows	✗
Crickets Bats	✗
Golf Clubs	✗
Hockey Sticks	✗
Lacrosse Sticks	✗
Pool Cues	✗
Skates Including ice skates and rollerblades.	✓
Ski Poles	✗
Spear Guns	✗



Our study: 1) Categorically-defined targets. 2) Looked for 20 categories at once (0-3 on any given trial). 3) Targets appeared with varying frequency.

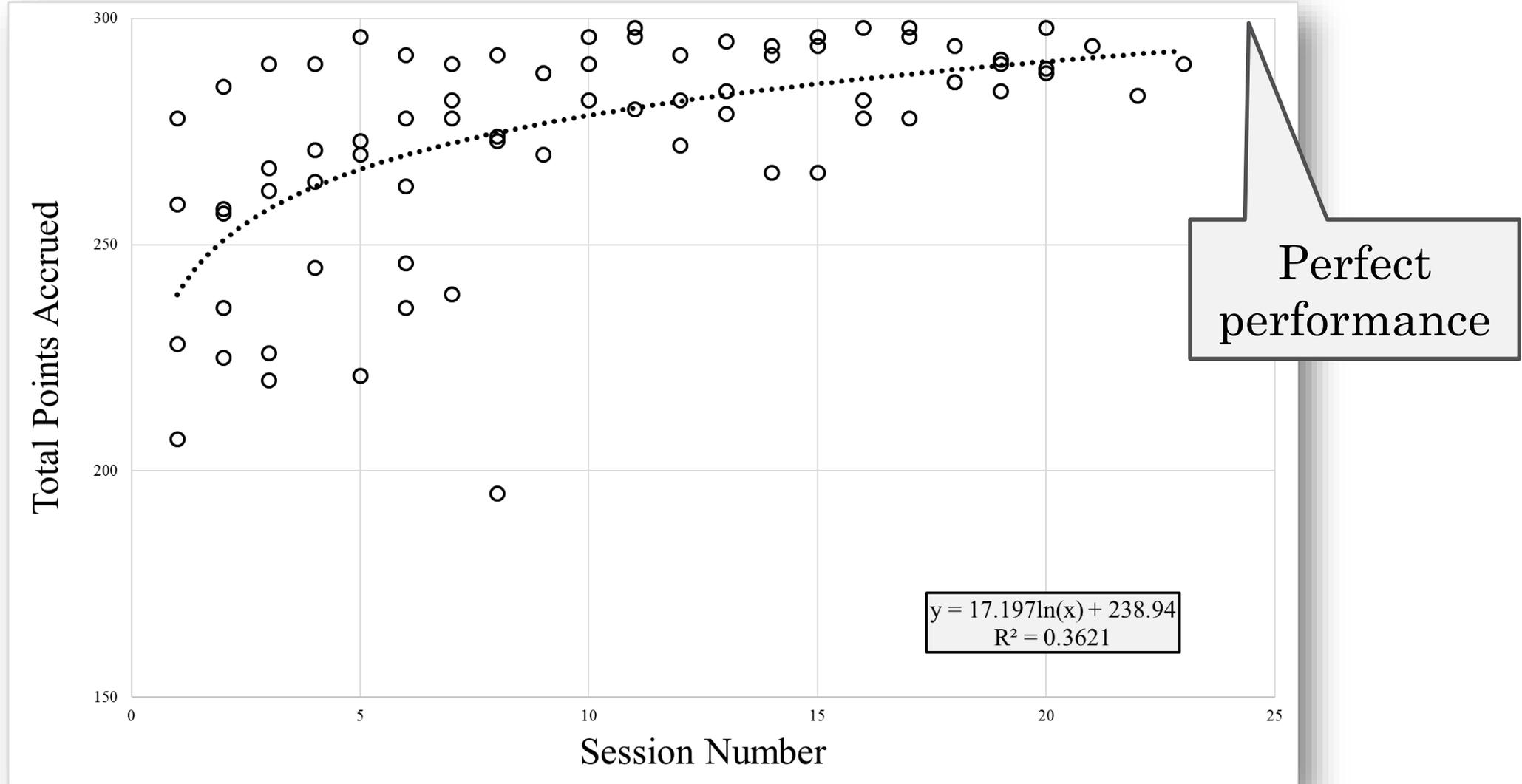


- Recorded eye-movements over (up to) 23 experimental sessions.

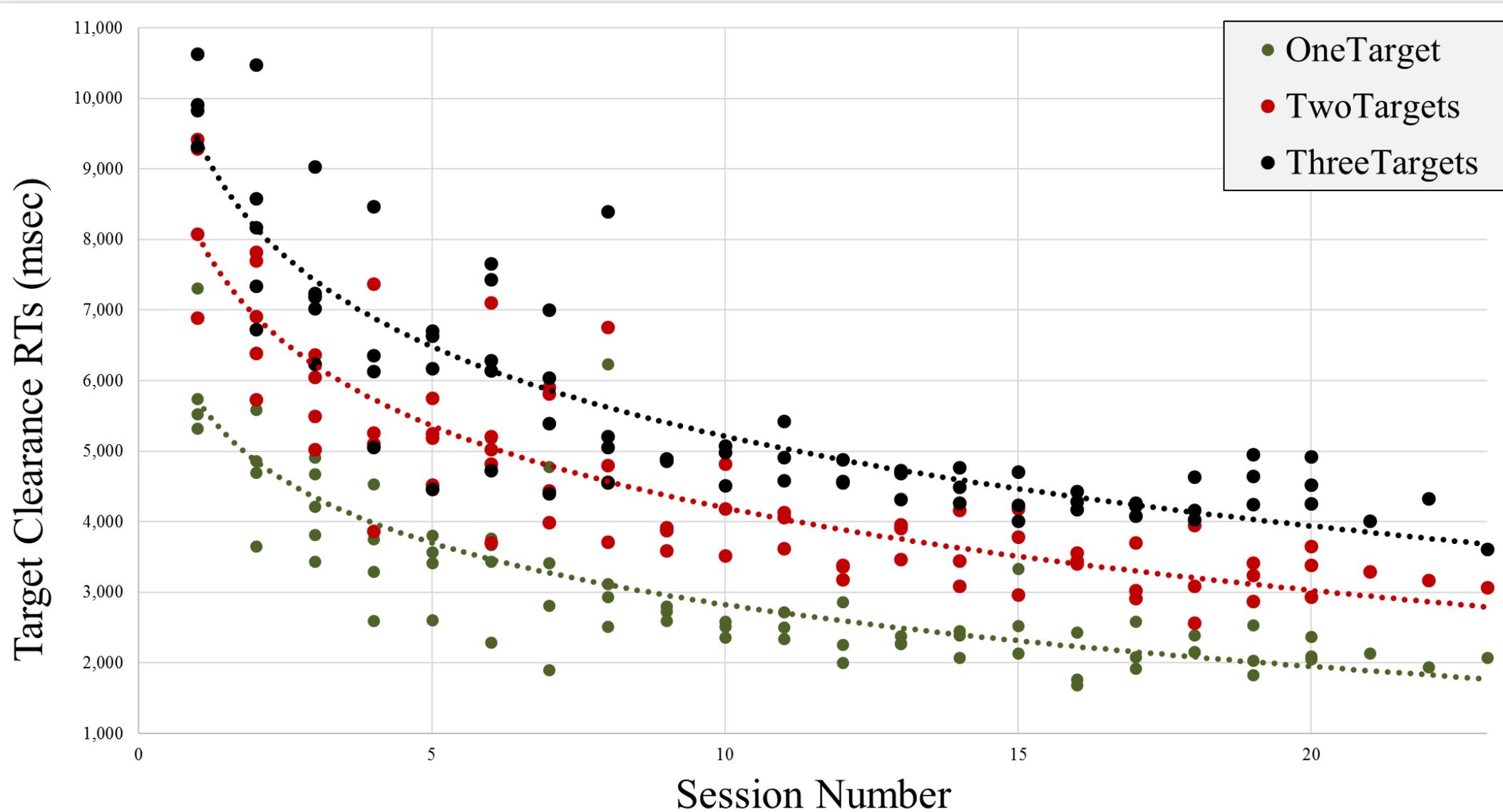


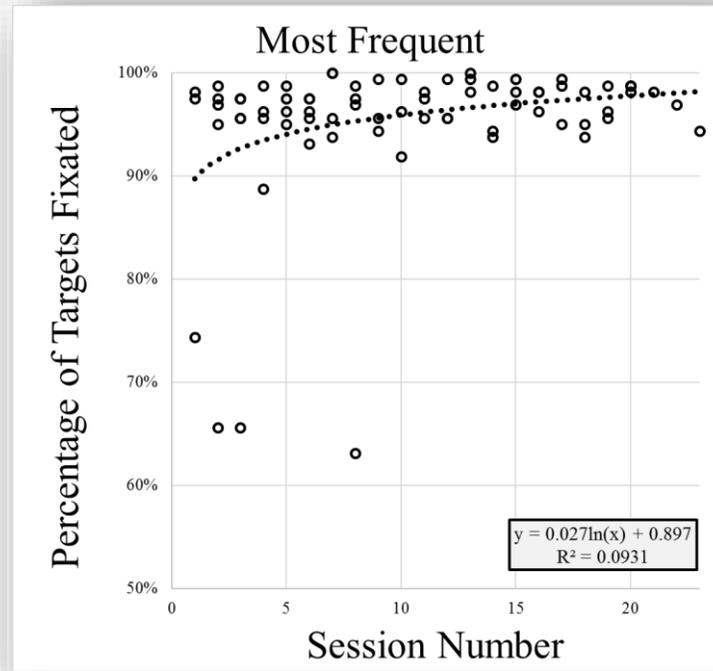
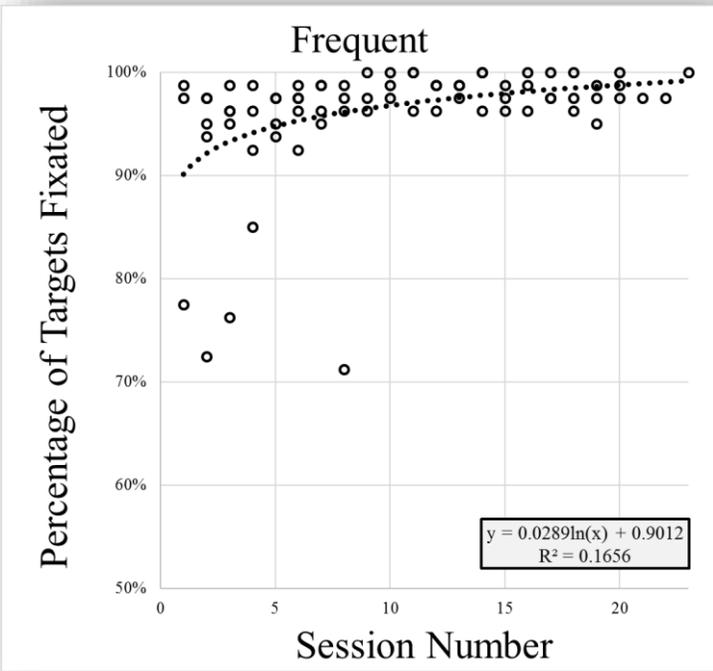
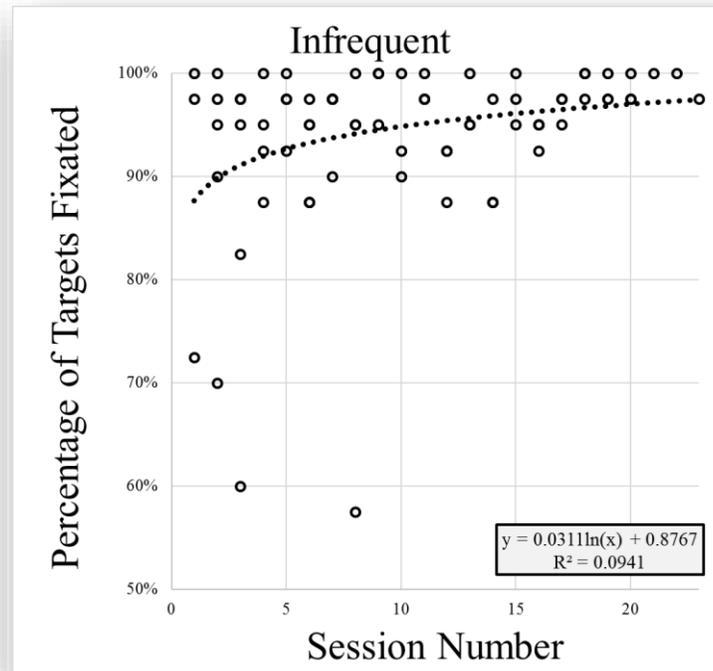
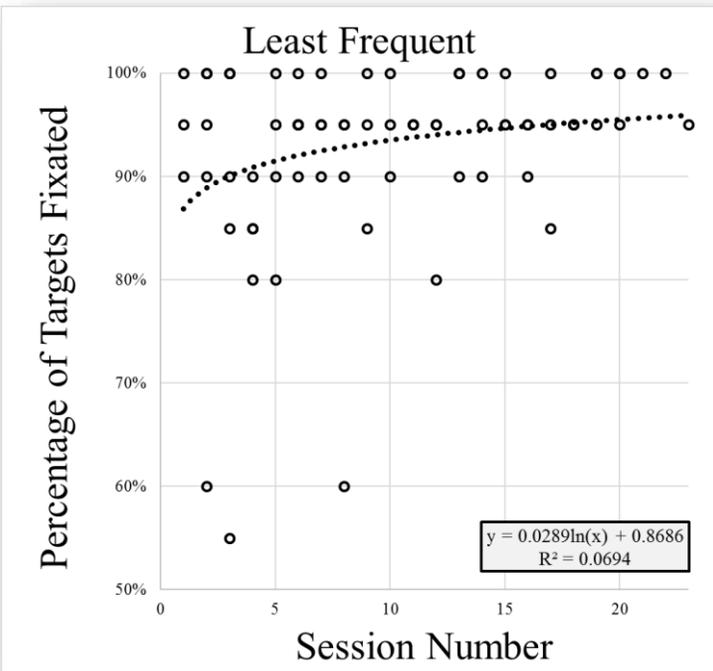
- Selected items highlighted in black.
- “Stop sign” indicated searcher was finished.
- 5 blocks of 40 trials, per session.
- Equal number of 0-3 target trials.
- Participants acquired points for accuracy (hits +1; misses/false-alarms -1).
- Block-level feedback was provided regarding performance.

- Largely qualitative analysis, given the small sample size.
- Each dot is one participant, one session.
- Over time, Ps neared perfect performance (300 points).

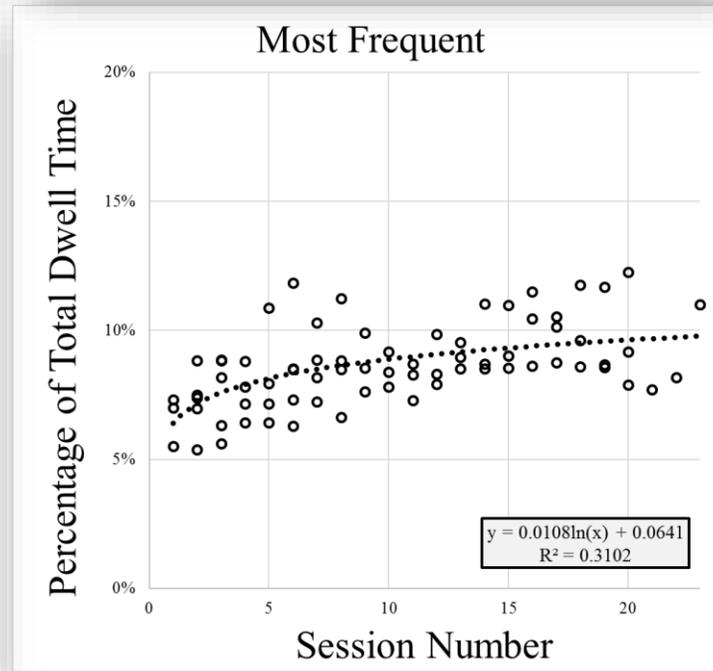
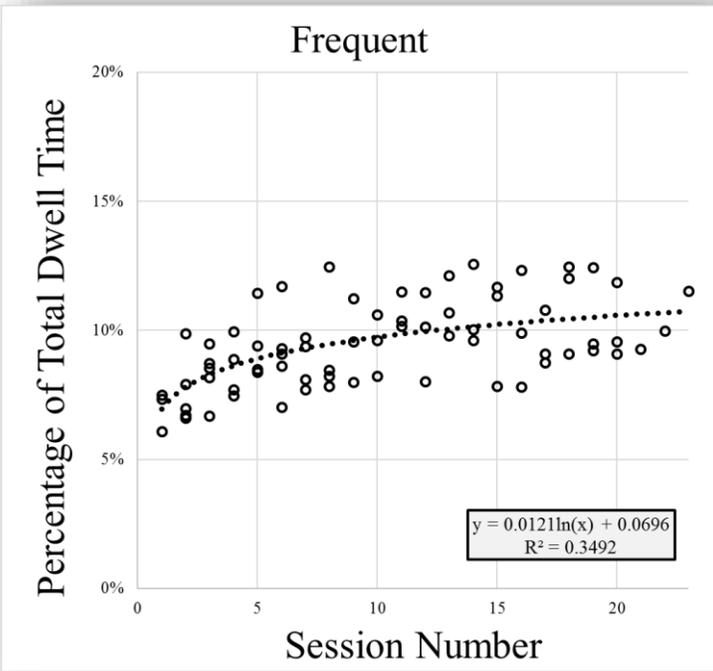
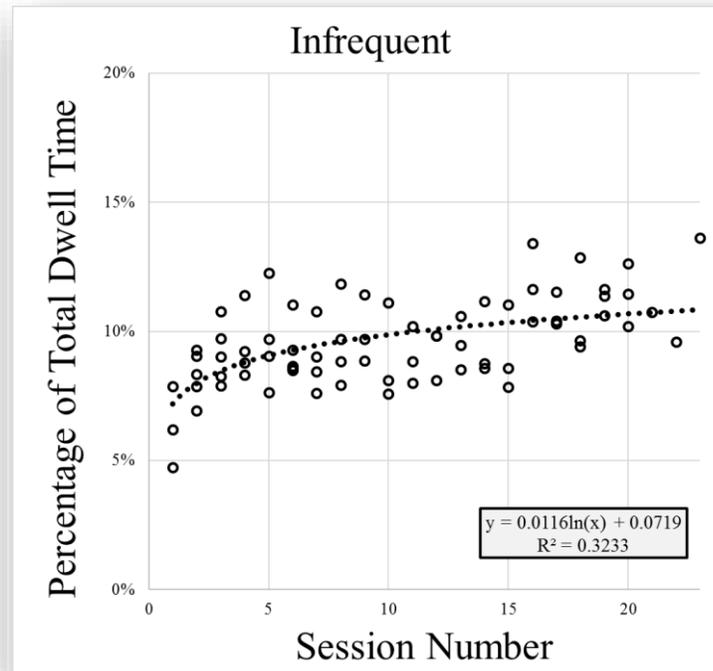
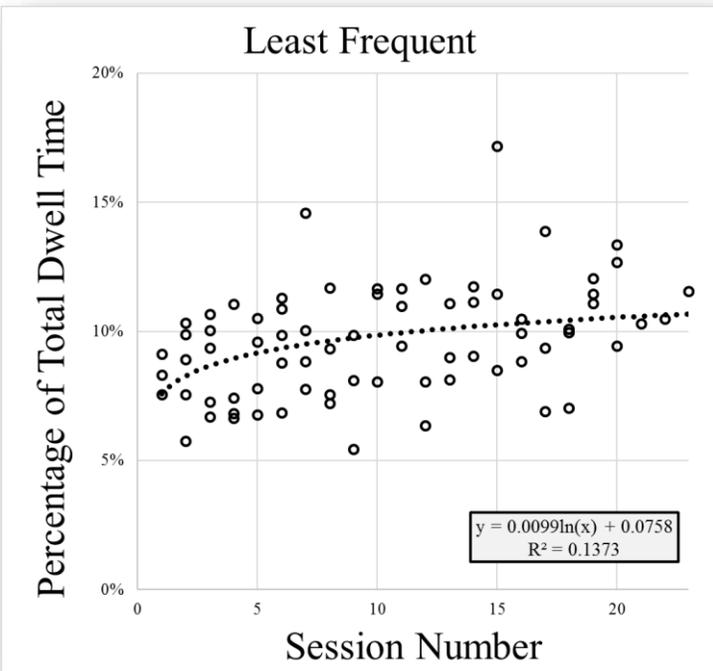


- Over time, Ps more quickly located any/all targets.



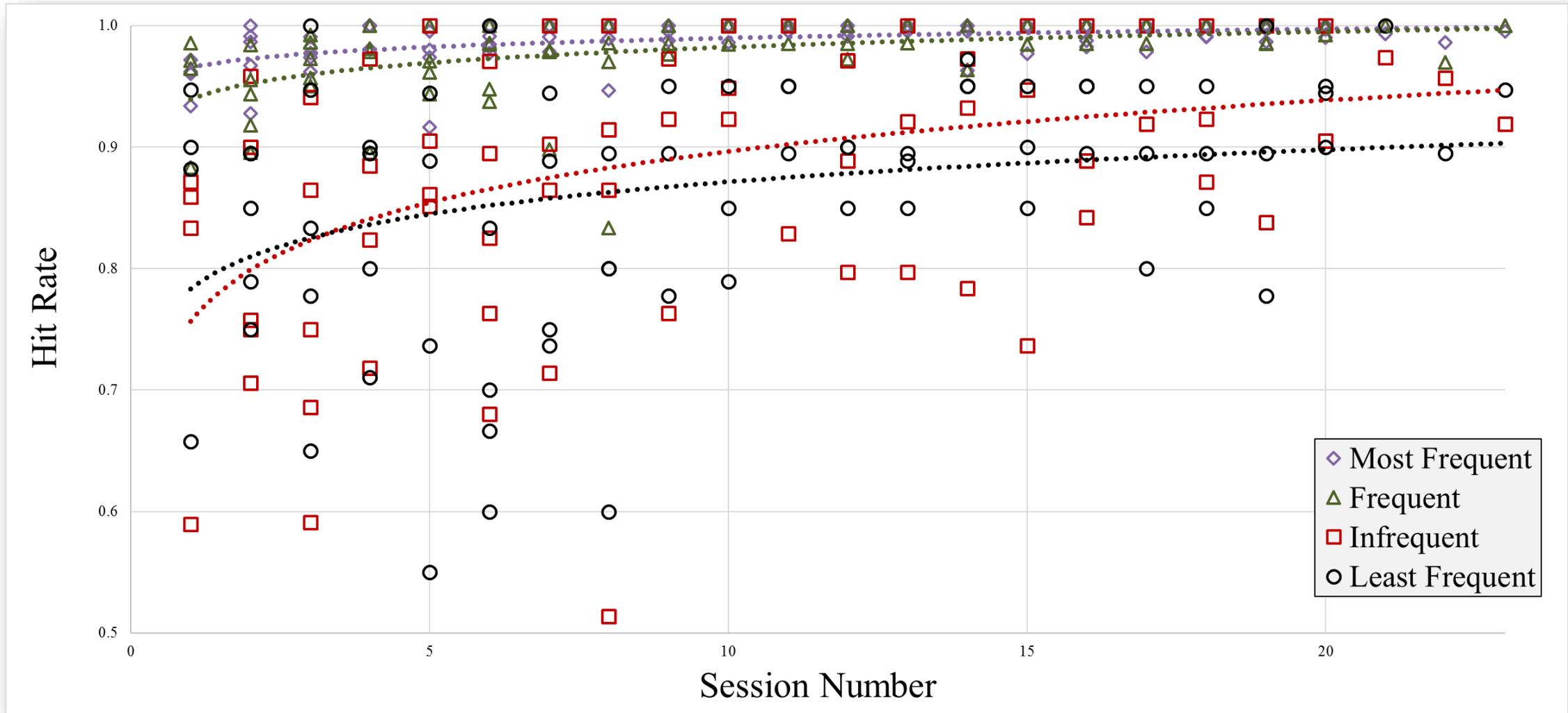


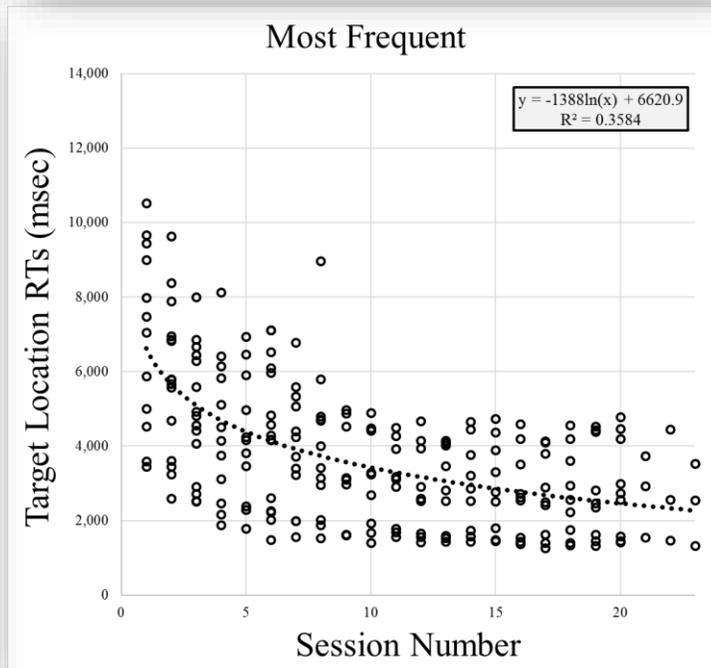
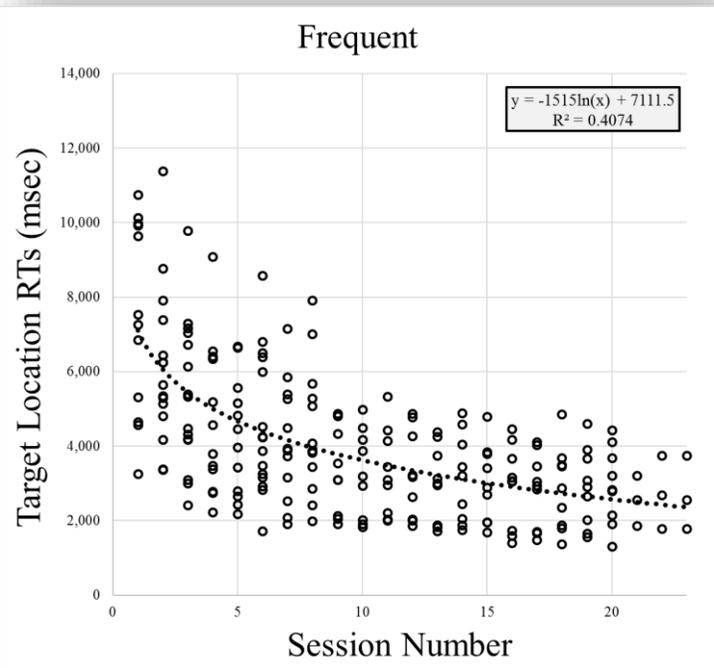
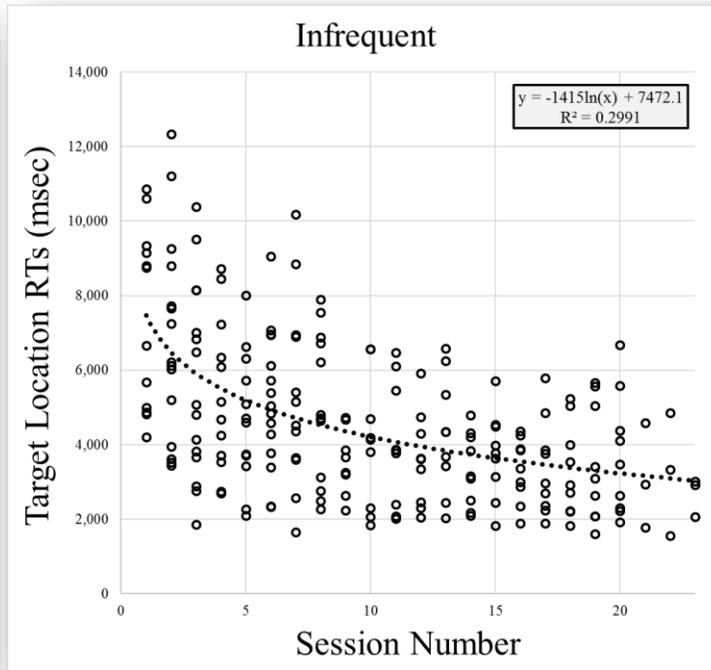
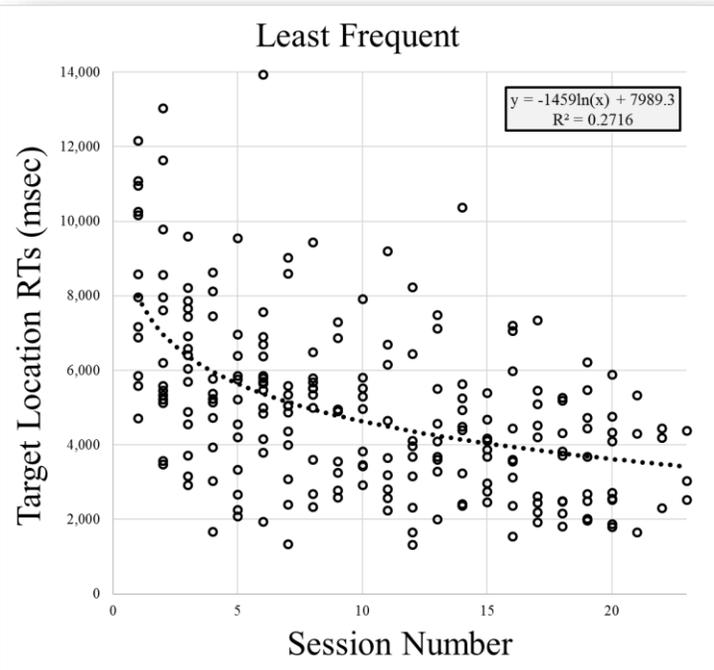
- Ps got better at affixing attention to targets...



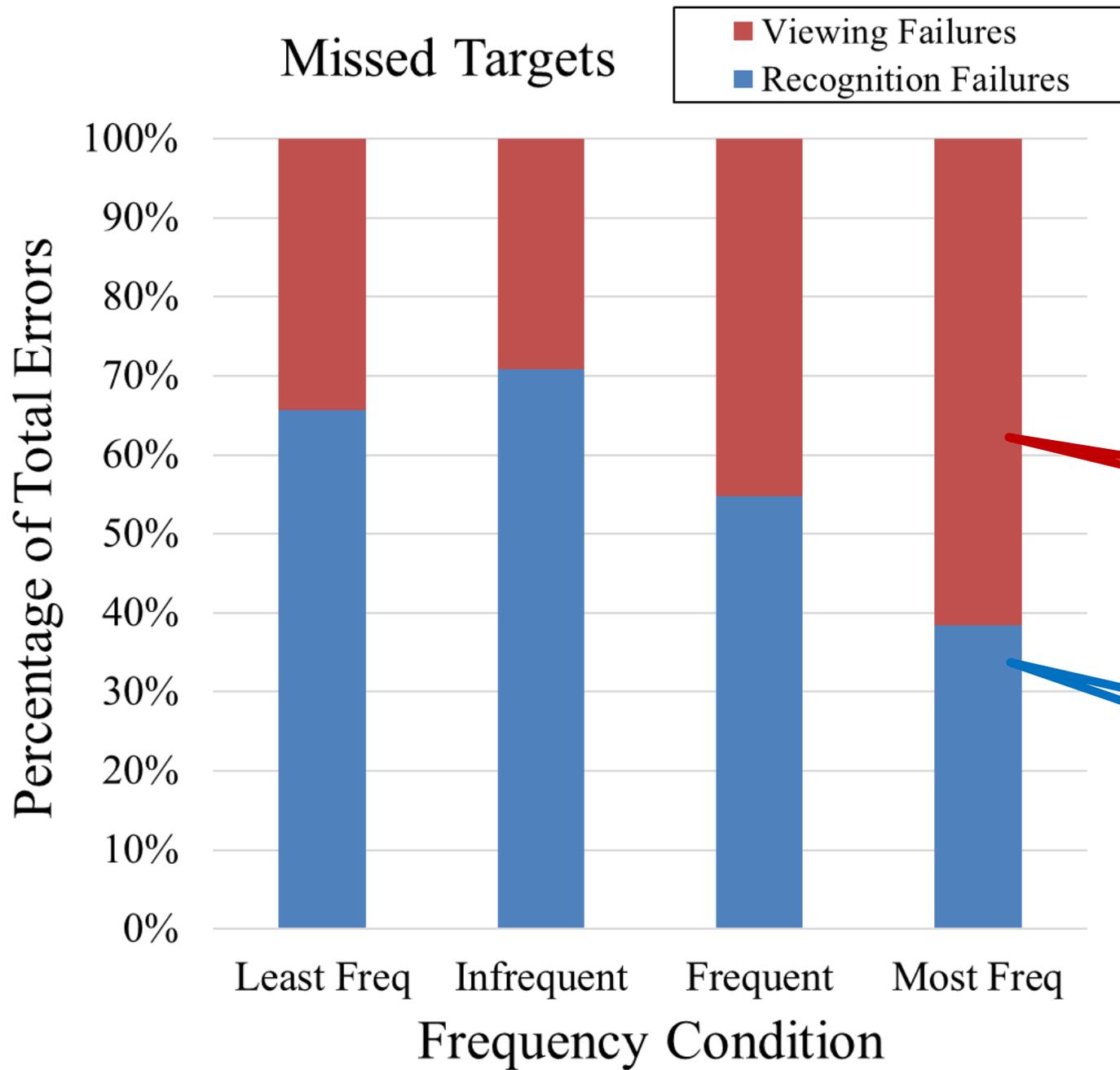
- ...and spending proportionately more time examining them, relative to distractors!

- Frequency (aka “prevalence”) effects diminished, but did not disappear.
- More frequent targets were still more likely to be found.





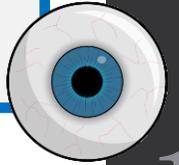
- More frequent targets also consistently located faster than infrequent ones.



- Low-frequency targets suffered more recognition failures, relative to higher-frequency targets.
- $\chi^2(3) = 50.47, p < .001$

Viewing failure: did not fixate the target

Recognition failure: fixated, but did not recognize target



- Data are consistent with previously published findings regarding the “low-prevalence effect.”
- Data are also consistent with diminishing (but not eliminated) frequency effects among collaborative search partners.

Journal of Experimental Psychology:
Human Perception and Performance

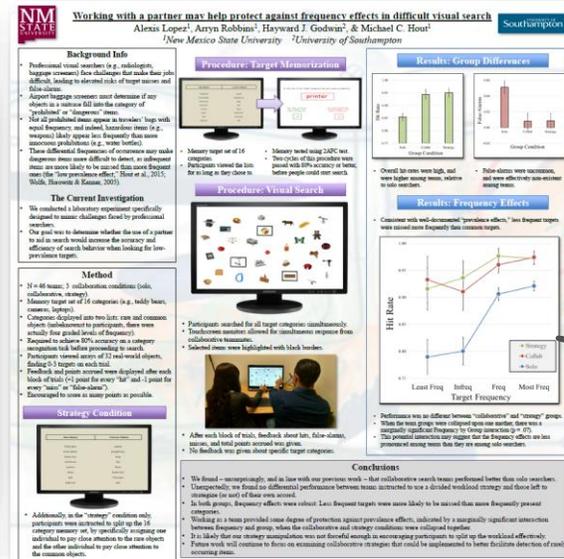
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0096-1523/15/\$12.00 http://dx.doi.org/10.1037/xhp0000053

Failures of Perception in the Low-Prevalence Effect: Evidence From Active and Passive Visual Search

Michael C. Hout
New Mexico State University

Stephen C. Walenchok and Stephen D. Goldinger
Arizona State University

Jeremy M. Wolfe
Brigham and Women's Hospital, Cambridge, Massachusetts, and Harvard Medical School



Catch Alexis Lopez at her poster!

- Taken together, our findings suggest that, as expertise is acquired, searchers learn to refine their mental representations for target categories, particularly common ones, and become more effective at restricting attention to the most relevant features.
- Stay tuned for more data!

- Thank you from the Vision Sciences and Memory Laboratory



Come see our other presentations on hybrid search, collaborative search, gambling behavior, and multi-dimensional scaling! All during the poster session today at 1:50pm.



Megan Papesh,
LSU