

**Supplementary Figure 1: Palinopsia questionnaire - Part A (Persistent afterimages).** Questions used to screen for persistent afterimages of stationary objects or scenes (Q1) and, if present, collect a detailed description (Q2-Q16).

<b>A. Afterimages of stationary objects of scenes</b>
<b>These questions are about objects or scenes and not bright lights</b>
<b>1. Have you ever seen the image of an object or scene after it was removed, or you looked away or closed your eyes?</b> <input type="checkbox"/> yes <input type="checkbox"/> no <b>If yes, proceed to the next question. If no, proceed to section B on the next page</b>
<b>2. Of which objects or scenes have you seen images? Tick all that apply.</b> <input type="checkbox"/> images on the screens of electronic devices (e.g., computer, TV, phone, tablet) <input type="checkbox"/> objects or scenes that stand out strongly from their background <input type="checkbox"/> objects or scenes that don't stand out strongly from their background
<b>3. How bright are the objects or scenes of which you have seen images? Tick all that apply.</b> <input type="checkbox"/> brighter than their background <input type="checkbox"/> darker than their background
<b>4. Give some examples of objects or scenes of which you have seen images.</b>
<b>5. When the original object disappears or you look away, when does the image typically appear?</b> <input type="checkbox"/> immediately <input type="checkbox"/> after a delay of minutes <input type="checkbox"/> after a delay of hours
<b>6. Where in your vision do the images of objects or scenes occur?</b> <input type="checkbox"/> in the same location as the original object or scene, or moves with the eyes when you look around (e.g., if the object is in the centre of your vision, then the image is in the centre of your vision and stays in the centre if you move your eyes) <input type="checkbox"/> in a different location to the original object or scene (e.g., if the object is in the centre of your vision, the image appears in a different location)
<b>7. Typically, what colour are the images of objects or scenes?</b> <input type="checkbox"/> same colours as the original object or scene <input type="checkbox"/> initially the same colours as the object or scene, but fades to different colours over time <input type="checkbox"/> different colours to the object or scene <input type="checkbox"/> black, regardless of the colour of the object or scene <input type="checkbox"/> translucent
<b>8. Which best describes the appearance of the images of objects or scenes?</b> <input type="checkbox"/> A realistic image, as clear and detailed as the original object or scene <input type="checkbox"/> An indistinct image that is faded and/or less detailed <input type="checkbox"/> A distinct image, detailed but not as clear and realistic as the original object or scene
<b>9. In your own words, describe what the images of objects or scenes typically look like.</b>
<b>10. When you see an image of an object or scene, how long does it typically last?</b> <input type="checkbox"/> less than a second <input type="checkbox"/> 15 seconds or more <input type="checkbox"/> hours <input type="checkbox"/> 1 to 14 seconds <input type="checkbox"/> minutes <input type="checkbox"/> days
<b>11. How often do you see images of objects or scenes? Complete the following sentence.</b> <i>I typically see these images [ write a number ] _____ days per [select most appropriate] week / month / year</i>
<b>12. Do you see images of objects or scenes more than once in a day?</b> <input type="checkbox"/> never <input type="checkbox"/> occasionally <input type="checkbox"/> more often
<b>13. Do you see images of objects or scenes before a headache?</b> <input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> always
<b>14. Do you see images of objects or scenes during a headache?</b> <input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> always
<b>15. Do you see images of objects or scenes after a headache?</b> <input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> always
<b>16. Describe a typical example of situation where you have noticed images of objects or scenes.</b>

**Supplementary Figure 2: Palinopsia questionnaire - Part B (Trailing).** Questions used to screen for afterimages trailing behind moving objects (Q1) and, if present, collect a detailed description (Q2-Q13)

<b>B. Afterimages of moving objects</b>	
<b>These questions are about moving objects and not moving bright lights</b>	
<b>1. Do you ever see a series images trailing a moving object?</b>	<input type="checkbox"/> yes <input type="checkbox"/> no
<b>If yes, proceed to the next question. If no, you are not required to answer any more questions.</b>	
<b>2. Of which moving objects have you seen trailing images? Tick all that apply.</b>	<input type="checkbox"/> images on the screens of electronic devices (e.g., computer, TV, phone, tablet) <input type="checkbox"/> objects or scenes that stand out strongly from their background <input type="checkbox"/> objects or scenes that don't stand out strongly from their background
<b>3. How bright are the moving objects of which you have seen trailing images? Tick all that apply.</b>	<input type="checkbox"/> brighter than their background <input type="checkbox"/> darker than their background
<b>4. Give some examples of moving objects of which you have seen trailing images.</b>	
<b>5. Which best describes the trailing images?</b>	<input type="checkbox"/> a series of separated images in the trail of the moving object <input type="checkbox"/> a series of images blurred together in the trail of a moving object
<b>6. Which best describes the appearance of the trailing images?</b>	<input type="checkbox"/> same colour and brightness as the moving object <input type="checkbox"/> same colour as the moving object but less bright
<b>7. In your own words, describe what the trailing images of moving objects typically look like.</b>	
<b>8. How often do you see trailing images of moving objects? Complete the following sentence.</b>	<i>I typically see these images [a number] _____ days per [select most appropriate] week / month / year</i>
<b>9. Do you see trailing images of moving objects more than once in a day?</b>	<input type="checkbox"/> never <input type="checkbox"/> occasionally <input type="checkbox"/> more often
<b>10. Do you see trailing images of moving objects before a headache?</b>	<input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> always
<b>11. Do you see trailing images of moving objects during a headache?</b>	<input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> always
<b>12. Do you see trailing images of moving objects after a headache?</b>	<input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> always
<b>13. Describe a typical example of a situation where you have noticed trailing images after a moving object.</b>	

**Supplementary Table 1:** Neuroactive medication taken by subset of participants with VSS

<b>Neuroactive medication</b>	<b>Participant count</b>
escitalopram	4
venlafaxine	3
desvenlafaxine	1
gabapentin	1
methylphenidate	1
methylphenidate and sodium valproate	1

**Supplementary Table 2: Afterimage characteristics in VSS**

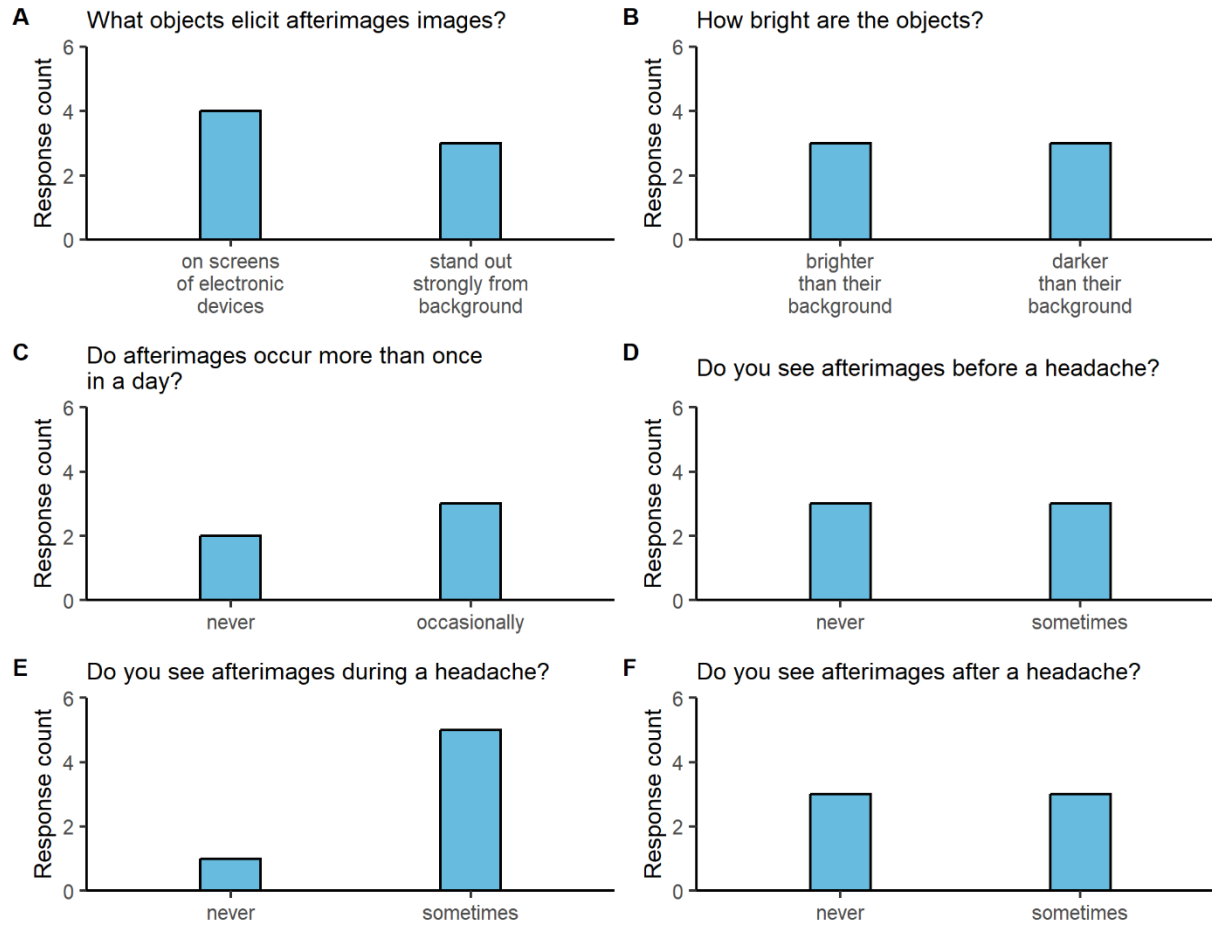
id	group	object examples	afterimage colour	image type	afterimage description	duration	frequency	situations
1	VSS	cars	same colour	distinct	afterimage translucent	<1 s	once a month	moving head while looking at car
2	VSS	looking away from the tv or computer screen, movies that have a bright background and a dark object, looking at my phone in the dark	same colour	indistinct	if I see a person, I will see a silhouette of the person, objects stay the same shape, after a while it slowly fades away	1-14 s	twice a week	watching a bright video in a dark room
3	VSS	removing my water bottle from the nightstand to drink, after image against wall; green crossing sign after it returns to red	fades to different colours	indistinct	blurry, flat, floating, light-filled; kind of like a misty light through cellophane, caught on the surface of my eye	minutes	daily	while laying down still on my bed if I look around and focus on a new scene then move my eyes the scene will follow
4	VSS	screens, furniture, cars	fades to different colours	distinct	typically they start out lighter than the original object but with the same amount of detail. After they fade they lose detail, become darker and change colour.	1-14 s	fives times a week	During the afternoon, there is a chair that catches the sunlight in my room in such a way that it shines brightly
5	VSS	bookshelf (dark against white wall), stove (light against dark), lots of screens, trees	different colour	indistinct	usually shadows, frequently with a bruised purple colour, sometimes white/turquoise	1-14 s	daily	all the time-random?
6	VSS	black text on white or contrasting background (screens, paper), buildings and trees, people	different colour	distinct	mainly appear to be a negative of what the original object was. Just as detailed/clear as the initial object or scene but fades eventually	1-14 s	daily	looking at an object or scene that is reflecting daylight outside. An example could be looking at a person during a conversation
7	VSS	prolonged viewing of an object or person	black	indistinct	akin to shadows of the original. Not defined, instead more general/fluid	15 s or more	daily	having a conversation with another person or reading or straining my eyes, especially in cases of distinction between light/dark
8	VSS	signs on tram stops, trees, tv scenes of people talking	black	indistinct	sort of like shadows, like a jumbled collection of mostly dark coloured debris forming itself into the shape of what I saw, like how I'd imagine the flip side if the world was 2D	1-14 s	fives times a week	just walking down the street, there will be a lot of stimuli and lots of it will seem to imprint and overlap
9	VSS	words on laptop, traffic lights	black	distinct	dark coloured, same shape as the original object or scene, not very distinct, more fuzzy	1-14 s	four times a week	Anytime I look at the screen of my laptop
10	VSS	when object disappears on a monitor, e.g. last scene on a YouTube video; simple shapes, edges	black	indistinct	like a shadow, usually only the outline of the object	<1 s	three times a week	on a monitor, under bright light
11	VSS	phone screen, TV, windows	translucent	indistinct	faded copy of the bright and dark elements	1-14 s	daily	looking up from my computer at work
12	VSS	outlines of trees against the sky visible when looking up; outlines of people when looking at them and then away from them	translucent	distinct	white filled version-outline most clear-disappears always within 10 seconds (bright environment); dark filled version same as above (dark environment)	1-14 s	daily	on bright sunny days; in a bright room with artificial lights and bright/white walls
13	VSS migraine	people on the screen, pictures of flowers, logos on large signs	same colour	indistinct	a patch of colour (usually a bright solid colour) that is in the rough shape of the thing I was looking at	1-14 s	twice a week	If I'm looking at a bright screen, typically in the dark

id	group	object examples	colour	type	afterimage description	duration	frequency	situations
14	VSS migraine	lamps, cups, movies and shows during a scene change	fades to different colours	distinct	same shape but sometimes different colours/opposite, stays right in centre and moves with my eye	15 s or more	daily	usually when on my phone, watching TV, riding in car. Usually when I am relaxed and looking at something for a while
15	VSS migraine	trees, buildings	different colour	indistinct	like a shape or silhouette of the object that sort of seems/feels like a photo negative	1-14 s	daily	usually where things are well lit and have a strong contrast to their background e.g., outside on a sunny day, an illuminated object against a dark background
16	VSS migraine	desk, my hand, pen, walls	different colour	indistinct	either pink green or both; like a silhouette, low detail, colour intensity varies	1-14 s	daily	day to day life; in white or well-lit rooms especially
17	VSS migraine	people, this document,	different colour	indistinct	faded memories of the object, shadowy and indistinct, it is more the outline of the object, sometimes different faded and translucent colours	1-14 s	daily	after looking at someone or something that is against a stark background
18	VSS migraine	people, features on walls, reflections on cars	different colour	indistinct	often an inverse of the object (colour-wise), varying clarity depending on how contrasted the object is to the background or how long I've been looking at it- the object shape will be the same but if I'm looking for a while, the inside shape will have more detail (e.g. facial features)	1-14 s	daily	often when I've been looking in the same place for a while -in conversations where I'm across from someone, in meetings
19	VSS migraine	TV/computer (i.e. lit background), fences, windows and frames, lights, trees against bright backgrounds, striped/shaped images	different colour	distinct	clear silhouette and sometimes more detail, usually dark on lighter backgrounds but can be light on darker background or "opposite" colour	minutes	daily	brightly lit areas
20	VSS migraine	phone, paintings/vivid patterns, big bright shapes, traffic lights	different colour	distinct	It looks like a solid shape (not detailed outline) but usually a solid colour, not necessarily the original colour	1-14 s	three times a week	after a headache/migraine or very tired (2+ nights of poor sleep) usually afternoon/evening and if I have looked at close up objects e.g., phone/computer/reading
21	VSS migraine	writing on books or screens, anything against a bright sky	different colour	distinct	usually brightly coloured (blue, green, turquoise) silhouette of object	1-14 s	twice a month	often I have a headache but not always. Usually in bright light
22	VSS migraine	images on screens, people, random objects like chair or cup or ceiling fan, road lines	different colour	indistinct	fuzzy outlines or blobs in the shape of the object, bright white or blue or green in colour	1-14 s	twice a week	occurs randomly when looking at everyday objects inside in normal lighting
23	VSS migraine	phone over a desk (phone not being on). White letters on a black background. People's clothes (i.e. stripes on shirts/black t-shirts)	translucent	indistinct	for the first second or two, the image is clearer and looks like the colours are inverted, then it quickly turns into a translucent image that floats around, doesn't necessarily follow my eyes	minutes	daily	white backgrounds- when at home looking at walls and picture frames. Black backgrounds i.e., phone screen on battery saver mode
24	VSS migraine	everyday objects, people in front of bright light	translucent	distinct	the object/person typically looks the same/similar but bright white or translucent. Often moves in visual field quickly.	1-14 s	three times a month	occasionally associated with headache, more random than headache associated, more frequently when tired
25	VSS migraine	large pieces of furniture	translucent	indistinct	colourless shadow in the shape of the object	1-14 s	twice a year	when I am very tired or stressed

**Supplementary Table 3: Trailing in VSS**

id	group	object examples	appearance	detail	trailing description	frequency	situations
3	VSS	scrolling text on phone, people's limbs when walking, lamp posts on the tram, arms of people waving	images blurred together	same colour but less bright	5-6 blurred copies of the object, slowly becoming more transparent the further they move	daily	light things against dark, like lampposts, people. It is stronger at night.
4	VSS	cars, people, balls	separated images	same colour but less bright	they look like a series of screenshots of the image or like frames in an animation	once a week	watching cars go by under certain light conditions
5	VSS	poles, cars, sometimes birds or balls being thrown	separated images	same colour but less bright	a blur effect as if times is stretching, distinct but overlapping	three times a week	random
6	VSS	car driving across my vision	images blurred together	same colour but less bright	typically the same as the initial object but less bright and slightly blurry	daily	sitting at a traffic light watching the cars drive across my vision
7	VSS	in the case of distinct object/background I will very rarely notice them	images blurred together	same colour but less bright	similar to afterimages but more immediate and instead of moving my eyes for the trailing to occur it happens inherent to the object	5 times per year	car driving past
12	VSS	people running, cars moving	images blurred together	same colour but less bright	blurred, translucent vague shape, not clear outlines and does not contain fine details or textures	daily	person running fast, objects moving fast
14	VSS migraine	my hand, anything moving side to side in front of me	separated images	same colour but less bright	like a flip book or stop motion, less intense than the original object	daily	my hand, people walking by
15	VSS migraine	things moving on a screen	images blurred together	same colour but less bright	kind of like a smear effect behind the object	once a month	usually things moving on a screen
16	VSS migraine	trains, trams	separated images	same colour and brightness	distinct from each other trailing versions of themselves	daily	well-lit white rooms it tends to be more noticeable, generally the more stressed I am the more I notice
17	VSS migraine	my hands, anything that I move in my hands like a pen	images blurred together	same colour but less bright	blurred continuation of the image or object	daily	my hands, it is more noticeable when it is moving faster
18	VSS migraine	cars, my own hands	images blurred together	same colour but less bright	looks like a blur or like someone's added an effect to a movie	twice a week	usually when I've just woken up, looking out my window and seeing cars drive past
19	VSS migraine	usually lights where light seems to follow my eye movement e.g. lights on a car, torches	images blurred together	same colour and brightness	starts as bright as the original object and then fades	once a week	usually lit objects e.g. cars but after the car has gone, occasionally screen-based images
20	VSS migraine	arm/fingers (close up objects e.g. not cars)	images blurred together	same colour but less bright	the moving object is moving like a slow movie, smooth and not disjointed	twice a month	after a migraine/poor sleep for 2+ nights, darker environment
23	VSS migraine	hands moving	images blurred together	same colour but less bright	it looks like a slow-motion movie, as if the image is trying to catch up to the object, it is blurry and faded	daily	if the moving object is close to my eyes i.e. my hands or someone gesticulating in front of me during a conversation (their arms and hands)

**Supplementary Figure 3: Characteristics of persistent afterimages in migraine. (A-F)** For each question, the number of individuals selecting each response option is shown for the participants with migraine alone who reported persistent afterimages (n=5). Questions and responses are abbreviated (see Supplementary Fig. 1 for full text).



**Supplementary Table 4:** Afterimage characteristics in participants with migraine alone

<b>id</b>	<b>delay</b>	<b>object examples</b>	<b>afterimage colour</b>	<b>image type</b>	<b>afterimage description</b>	<b>duration</b>	<b>frequency</b>	<b>situations</b>
1	immediate	computer screen images, words	fades to different colours	indistinct	at first they are really clear and then they fade	1-14 s	five times a month	after studying for a long time, for hours
2	immediate	images with distinct outlines or shapes e.g. black star clipart on white phone screen	fades to different colours	indistinct	faded almost as if the colours have been bleached by sunlight over time (but relatively bright at first)	1-14 s	three times a week	after reading white text on black phone screen of average font size in dark (non-reading) mode
3	immediate	numbers on testing room wall	different colour	distinct	reverse colours, dull intensity but bright colours	1-14 s	twice a month	when I've looked at something bright with contrasting colours
4	immediate	objects in the foreground of vision, so screens (but not images on screen), appliances i.e. microwave, lamps etc	black	indistinct	it would be the outline of the object, all black but with white/gold border that is bright	1-14 s	twice a week	tired, end of day looking at screen. When my vision is disturbed by a headache or in the aftermath
5	immediate	shapes and faces of television programs on a screen, water bottle	translucent	indistinct	shadow or only the main part of the object like a faded contrast image of the same colour	<1 s	three times a month	looking at an object that contrasts with the background for an extended period of time