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Abin da kake kallo na iya dacewa da yadda visual brain ɗinka yake tuned

Wani bincike a Nature Human Behaviour ya haɗa stable gaze habits na mutum — ko yana yawan fara kallo da daɗewa a faces ko text a complex scenes — da distinctiveness da girman matching category-selective regions a visual cortex. Ba ikirari ba ne cewa mutane suna ganin duniyoyi daban a zahiri ko kwakwalwa ce ke tilasta gaze pattern; correlation ne mai taka-tsantsan: a manya, active looking da category maps na kwakwalwa suna bayyana suna daidaita da juna.

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Idanu ba sa yawo bazuwar hanya kawai

Ka sa mutane biyu a gaban hoto ɗaya mai cike da abubuwa, ba za su bincike shi iri ɗaya ba. Idanun mutum ɗaya suna tsalle da sauri zuwa fuskoki. Wani kuma yana yawan sauka kan rubutu. Waɗannan bambance-bambancen ba zaɓi ne na ɗan lokaci kawai ba. A wannan binciken, sun kasance halaye masu ɗorewa: a cikin hotuna ɗaruruwa, mutane sun nuna halayen kansu da ake iya maimaitawa a abin da suka fara kallo da tsawon lokacin da suka tsaya a kansa.

Tambayar mai ban sha'awa ita ce me waɗannan halaye suka danganta da shi. Shin preferences ne kawai — mutum mai son hulɗa da jama'a yana kallon fuskoki, mai karatu yana kallon kalmomi — ko suna da alaƙa da yadda visual brain na kowane mutum yake wakiltar waɗannan categories?

Diana Kollenda, Elaheh Akbari, Maximilian Broda da Benjamin de Haas sun gwada wannan alaƙa kai tsaye. Sun haɗa eye tracking yayin free viewing na natural scenes da wani fMRI gwaji daban da ya tsara yadda visual cortex na kowane participant ke amsa categories kamar fuskoki da kalmomi. Sakamakonsu ana iya faɗa a takaice da kulawa: mutanen da suka fi karkata su kalli fuskoki suna da face representations da suka fi distinctive a right ventral visual cortex; mutanen da suka fi karkata zuwa rubutu suna da word representations da suka fi distinctive a left ventral visual cortex.

Wannan ba ya nufin kwakwalwa tana tilasta idanun su motsa ta hanya ɗaya, ko kallon kalmomi shi kaɗai yana gina "word area." Takardar ba causal ba ce. Amma tana nuna cewa **active vision** — yadda mutum ke ɗaukar samfurin duniya da idanunsa — yana daidaita da fine-grained layout na visual system ɗin wannan mutumin.

Abin da marubutan suka yi

Binciken yana da sassa biyu da aka ware sosai.

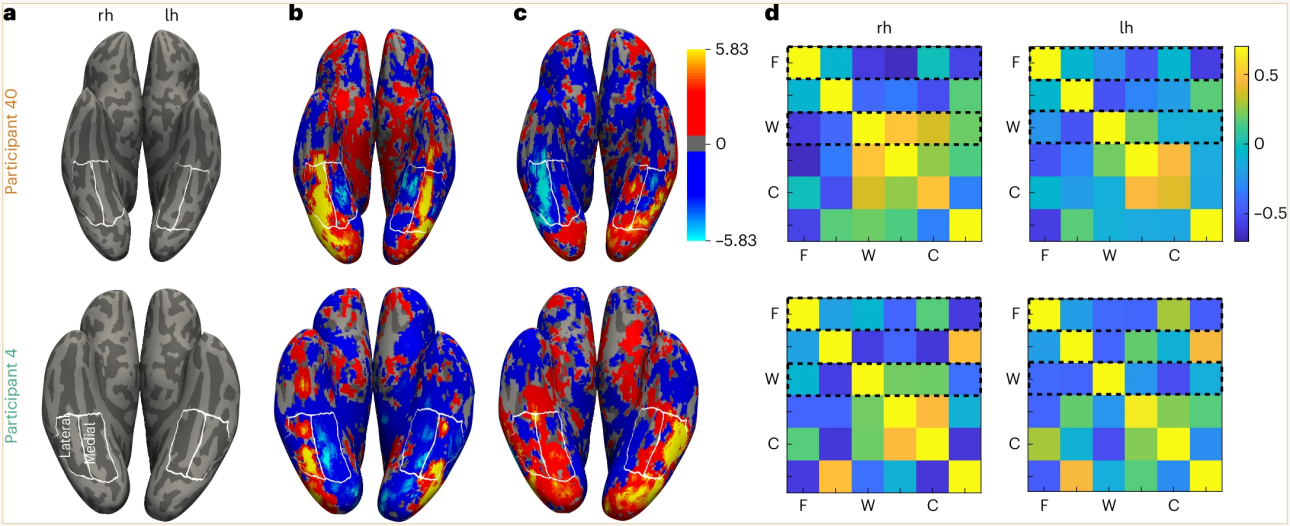
Da farko, manya 102 sun kalli complex scene images 700 cikin 'yanci yayin da aka rubuta motsin idanunsu. Masu binciken sun auna abubuwa biyu ga fuskoki da rubutu: inda participant ya fara kallo, da tsawon lokacin da ya ci gaba da kallon wurin. Wannan jimillar lokacin kallo ana kiranta **dwell time**.

Sun kuma gwada ko waɗannan halaye suna da stability. Ra'ayin **split-half reliability** mai sauƙi ne: ka raba hotunan gida biyu, ka auna halin ɗaya a sets biyu, sannan ka ga ko mutanen da ke sama ko ƙasa a ranking suna ci gaba da haka. Idan eh, halin reliable ne. A nan reliability ta yi yawa: ga fuskoki, r = 0.93 ga na farko fixations da r = 0.95 ga dwell time; ga rubutu, r = 0.87 da r = 0.88. Values kusa da 1 suna nufin tendency ɗin tana da stability sosai.

Na biyu, participants 61 daga cikinsu sun yi separate functional MRI gwaji. Functional MRI, ko fMRI, yana bin canje-canje a oxygenation na jini a matsayin indirect signal na waɗanne brain areas suka fi active yayin task. **Localizer** standard mapping task ne: a nuna known categories, kamar fuskoki ko kalmomi, a gano patches na cortex da suka fi amsawa ga category ɗaya fiye da sauran. Wannan ba free viewing ba ne. Participants sun kafe idanu a tsakiya yayin da aka nuna blocks na faces, pseudowords, bodies, houses, cars da limbs. Wannan design yana da muhimmanci: brain measure ɗin ba kawai sakamakon participants sun motsa idanunsu zuwa objects iri ɗaya cikin scanner ba ne.

Daga nan masu binciken suka tambaya yadda category response na kowane mutum yake distinctive a ventral

temporal cortex. Face pattern da ya fi distinctive yana nufin brain activity ga fuskoki ta fi consistently face-like kuma ta fi saukin raba wa da sauran categories. Word pattern da ya fi distinctive ma haka yake ga words da characters.



Misalan fMRI maps daga participants biyu da aka zaba daga subject list na binciken; top row da bottom row mutane biyu ne daban. A panel A, white outlines suna nuna yankunan ventral temporal cortex da binciken ya nazarta. Panels B da C suna nuna contrasts biyu: B yana haskaka cortex da ke amsawa da karfi ga fuskoki, C kuma ga written words. Panel D yana takaita yadda response patterns suka yi kama a object categories a matrix. Matrix 6 × 6 ce saboda localizer ya yi amfani da stimulus categories shida; F na nufin faces, W words, C cars, sauran rows da columns kuma comparison categories ne (bodies, houses da limbs). Stronger iri daya-category similarity da weaker cross-category similarity suna nufin brain representation ta fi distinctive ga category din. Ba wai kowane participant yana da map daya ba ne; binciken ya auna wadannan maps mutum bayan mutum.

Kollenda et al. / Nature Human Behaviour CC BY 4.0

Abin da suka gano

Babban pattern din category-specific ne.

Face distinctiveness a right lateral ventral temporal cortex ya yi correlation da tendency na participant na kallon fuskoki a independent free-viewing task. Alakar ta bayyana ga na farko fixations da dwell time. Word distinctiveness a left lateral ventral temporal cortex kuma ya yi correlation da tendency na kallon rubutu.

Takardar ta kuma tabbatar wannan ba kawai generic effect ne cewa “visual cortex ya fi karfi a wasu mutane” ba. Strongest links sun bi category da hemisphere da ake tsammani: faces a right lateral VTC, words a left lateral VTC. Cross-category links ba su ne labarin ba.

Neural measures din sun kuma hadu da behaviour. A smaller subsamples, stronger face distinctiveness ta hadu da better performance a Cambridge Face Memory Test, stronger word distinctiveness kuma da faster reading performance. Wannan yana ba neural measure wani external meaning: ba scanner statistic kawai ba ne, yana da alaka da abin da mutane za su iya yi.

Abin da wannan ba ya nufin

kanun labarai mai jan hankali zai ce “kwakwalwarka ce ke yanke abin da kake gani.” Wannan ya yi ƙarfi fiye da bayanan.

Binciken bai tabbatar da direction of causality ba. Mutum na iya yawan kallon fuskoki saboda face representations ɗinsa sun fi precise. Ko representations ɗin sun fi precise saboda shekaru na kallon fuskoki sun tsara wannan ɓangaren visual system. Ko duka biyun suna haɓaka tare. Marubutan sun bar wannan developmental question a buɗe.

Ba ya nufin mutane da gaze habits daban suna ganin physical scenes daban. Kowa yana kallon hotuna iri ɗaya. Bambancin yana cikin **sampling**: waɗanne objects ake ba priority, wane information ake tattarawa da farko, da waɗanne categories visual cortex ke wakilta da distinctiveness mafi yawa.

Kuma wannan ba diagnostic test ga individual ba ne. Correlations suna da ma’ana a group level, amma ba kayan aiki ba ne na cewa “brain map na wannan mutum zai faɗa daidai yadda zai kalli wannan hoto.”

Me ya sa wannan yake da muhimmanci

Ana yawan bayyana vision kamar idanu camera ne da ke ciyar da kwakwalwa information. Vision na gaske ya fi active. Ido yana zaɓar, lokaci zuwa lokaci, wane information zai kawo cikin high resolution. Waɗannan choices suna zama input da kwakwalwa ke koyo da aiki da shi.

Takardar nan ta sanya wannan loop a ƙasa mai ƙarfi. Ta haɗa active part — eye movements ta cikin scenes — da representational part — category-selective maps a ventral visual cortex — cikin mutane ɗaya. Sakamakon yana sa ya fi wahala a kula da “visual cortex organization” da “visual behaviour” a matsayin matakai daban. A manya aƙalla, suna bayyana suna daidaita da juna.

Wannan daidaitawar ita ce ainihin labari. Ba wai face-lookers wani irin mutum ne kuma text-lookers wani ba. Ba wai brain region ɗaya yana bayyana personality ba. Sakamakon ya fi ƙunci kuma ya fi amfani: stable differences a yadda mutane ke binciken visual scenes suna layi ɗaya da stable differences a yadda visual cortex ɗinsu ke wakiltar abubuwan da suke yawan nema da kaifi.

Taƙaitaccen bayani

Wani bincike a Nature Human Behaviour ya bi yadda manya 102 suka kalli complex scenes 700, sannan ya yi fMRI ga subset na participants 61 domin map category-selective visual responses. Mutanen da suka fi karkata su fara da kuma daɗe suna kallon fuskoki sun nuna more distinctive face representations a right lateral ventral temporal cortex; mutanen da suka fi kallon rubutu sun nuna more distinctive word representations a left lateral ventral temporal cortex. Neural measures ɗin sun kuma yi alaƙa da face recognition da reading performance a smaller subsamples. Binciken correlational ne, ba causal ba: yana nuna active gaze habits da category-selective brain organization suna daidaita a manya, ba wanne ne ya haifar da ɗayan ba.

Bincike ba tare da ƙawatawa ba

Abin da takardar ta nuna: Stable individual tendencies na kallon faces ko text a natural scenes suna da alaƙa da matching category-selective representations a ventral visual cortex.

Abin da yake mai yiwuwa amma ba a tabbatar ba: Long-term visual experience da brain tuning na iya ƙarfafa juna a development. Takardar ta dace da wannan idea, amma ba ta gwada direction ɗin development ba.

Abin da ba ta nuna ba: Mutane suna ganin duniyoyi daban a zahiri; gaze habits hardwired ne; ko fMRI maps suna haifar da eye movements.

Manyan iyakoki: Correlational design; adult university sample; smaller behavioural subsamples ga face recognition da reading; da separate fMRI localizer maimakon simultaneous free-viewing fMRI.

Yaya yawan amincewa ya dace? Babba cewa gaze tendencies na gaske ne kuma stable a wannan sample, matsakaici zuwa babba cewa suna da alaƙa da matching category-selective visual representations. Karami ga duk causal story har sai developmental ko intervention work ya gwada shi kai tsaye.

Majiyoyi

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https://doi.org/10.1038/s41562-026-02494-5

OSF repository for anonymized data, code and stimuli
https://osf.io/9fhxk/