

# Electroencephalogram (EEG) Based Imagined Speech Decoding and Recognition



Zkx s Zkw sx ç<sup>6</sup> ID 1Nçsúr sb ç<sup>6</sup> ID 1dr kxq Zr çks<sup>6</sup> IHL n LvRkno-P-øw yç<sup>6</sup> ID 1Hnk w ç Okvsç Ql s-o<sup>8</sup> ID 1  
H -kr sw Hl nç wkr s Rk-kño<sup>6</sup> 1Pkr Zksw Hr wkn<sup>6</sup> ID 1Hl çl kuk-Hl nç wuk-sw<sup>9</sup> ID

<sup>6</sup>Zákáo Roñ Skl y-káy-ñ ypYovskl ssañ kx n Bkáowsqox nò ypLvóná-snkvl' çsz w ox ál Ool os ] x séo-sañ yp[ onr x yw qñ [ skx tsx 855685 IJ r sxk

<sup>7</sup>I syw onsnkvLx qsx oo-sx q Koz k-áw ox ál ] x séo-sañ ypRy-sx 1WIT 36: 6: 1Pry-sx 2Usqo-sk

<sup>8</sup>Lvóná-snkvlkx n Lvóná-yx sm-Koz k-áw ox ál [ k-kl k Zákáo ] x séo-sañ 1Qyx qy 2Usqo-sk

<sup>9</sup>Lvóná-snkvlLx qsx oo-sx q Koz k-áw ox ál Hr wknç I owy ] x séo-sañ 1d k-sk 2Usqo-sk

Hl Z [ J [ A o -onox á sxéo-ásqkásyx-kx n knékn nò-sx swkqsx on -zoonr nonynsx q kx n -onyqx sásyx r k-á-ow ox nyç-ñ swz-yéon ár o nonynsx q yp-zoonr ns-onáñ p-yw l -ksx knásésáñ í sár ár o r ovz yp-ééo-kvx oç-yw swkqsx q áonr x s' ç o-ár ká k-s-á-ç-sx oí z yw-sx q ár o x oç-yw yqsnkvz-y nò-ø-yp swkqsx on -zoonr 3 s-noéowz w ox á vokn-áy k-s-á-z oyz vo í sár ns-kl swáo-áy l ox o á p-yw x oç-yz-y-ár oásmnoésmo-ár ká swz-yéo ár o vpo yp ár y-ø-ç-o-sx q p-yw x oç-yw yqsnkv ns-y-nò-3 s-zkz o-z-o-øx á-ár o -ç-w wk-ñ yp-onox á z-y-q-o-sx nonynsx q swkqsx on -zoonr ç-sx q Lvóná-yox nòz w yq-kz r ñ -LLN. -sqx kvl k-ár s-x oç-yw swkqsx q w oár yn ox kl w ç-áy w yx sáy-l -ksx knásésáñ í sár r sqr áow zy-kv-o-yç-ásyx l sá s-éo-ñ zy-ákl volwí ny-á l kx n -kpo-k-nyw z k-on áy yár o-w oár yn-3 o-opy-o l sá k q y n nkx nsnkáo sx sxéo-ásqkásyx q kx swkqsx on -zoonr nonynsx q p-yw ár o r ç w kx ny-áoi í r snr -ow kx-k nr kwox qsx q ák-u3 o z k z o-kv-y -oésoí -y w o -onox á áonr x s' ç o-l nr kwox qo-l p-ác-o -onyw w ox nkásyx-kx n zy-d-ø -yç-ásyx-áy swz-yéo z-y-ár oásmnoésmo-kx n ár o noéowz w ox á ypl -ksx nyw z çáo-sx áo-pkno-ñ-áow -I J P 3

Roñí y-n-ALLN1Pw kqsx on -zoonr 1K onynsx q 1Y onyqx sásyx 11 J PU oç-yz-y-ár oásmnoésmo

## LIST OF ABBREVIATIONS

HUU IH-ás nkvUoç-kvUoái y-u

HY IHç-áy Yoq-o-séo

I J PI -kx J ywz çáo-Bk áo-pkno

J HK IJ ywz çáo-Hsnon Kskqxy-s-

J K IJ y-ovkásyx Ksw ox-syx

J HY IJ yw w yx kéo-kqo-opo-ox nò

J ZWJ yw w yx Zz káskvWk o-x

J UU IJ yx éyç-ásyx kvUoç-kvUoái y-u

KI MKooz I osvopUoái y-u

KS IKooz Sok-x sx q

Ka [ 1Ks-moáo a kéovoá [ -kx-py-w

LLN ILvóná-yox nòz r kvq-kw

LJ yN ILvóná-y ny-ásny q-kz r ñ

LST ILi á-ow o Sok-x sx q T knr sx o

pT YPIMç-x nasyx kvT kqx oásmY o-yx kx nò Pw kqsx q

MJ T IMç-úñ J 2w okx -

MKY IMç-o-Ks-maw sx kx á Ykásy

MM [ 1Mç-áMç-so- [ -kx-py-w

NT T INkç-sx T si o-T ynov

OT T IOsnno T k-uyé T ynov

sLLN IB á-kmakx skvLLN

IJ HIB noz ox nox á J ywz yx ox á Hx kvñ-s-

u2UU lu2x ok-o-áU osqr l y-

SKHIS sx ok-Ks-maw sx kx á Hx kvñ-s-

T LNIT kqx oáy Lx nòz r kvq-kz r ñ

T RS IT çváz vo Ro-x ovSok-x sx q

T YMIT k-uyé Ykx nyw Mvov

T YPIT kqx oásmY o-yx kx nò Pw kqsx q

T ZIT çváz vo Zmo-y-s-

UPY ZIUok-Bk-pk-on Zz oná-çw Pw kqsx q

UI IUk séo I kño-

VJ HIWsx nsz kvj yw z yx ox á Hx kvñ-s-

WZKI Wj í o-Zz oná-çw Kox-sañ

WUUI Wyl kl sw-ásmUoç-kvUoái y-u

YMY kx nyw Mj-o-á

YSZ IY onç-séo Sok-áZ' çk-o-

YML IY onç-séo Mbkác-o Lvw sx kásyx

YX HIY onç-ox nò X ç kx ás nkásyx Hx kvñ-s-

ZJ WIZyí J y-ásmkvWj áox áskv

ZT YIZox-y-sw yáy-Yr nár w-

Z' T IZç z z y-á' onáy-T knr sx o

ZY ZIZsw z vo Ykx nyw Zkwz vsx q

ZMZIZo' ç ox áskvMbkác-o Zovonásyx

ZS IZç-pkno Skz vknkx

' LWI' s-çkvLéy uon Wj áox áskv

a Wj ía kéovoá Wknukqo [ -kx-py-w

a [ 1a kéovoá [ -kx-py-w

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# 1. INTRODUCTION

Uoç-ywkwqskx q áonnx's' ço—r kéo wkno k -sqxs nkxá nrxá-sl çáyx sx nonynsx q k l -ksx zr ñ-sywyqsnkv zr oxywox k k—sqxkv-áy nrxá-yvk l J P-ñ-áow 3 o-è-zr oxywox k sx mçno W855 oéyuon zyáox áskv-í-wí ny-áskvzyáox áskv-ZJ W1és-çkv oéyuon zyáox áskv-í- LW1kxn -èx-y-sw yáy--r ñár w—ZT Y. áy -o-áy-o w-á-é-o-l kv nywwçxsnkásyx py- zoyzvo í sár nywzvoáo kxçkqo -ñ-áow l çá no nsá sx éo-l kv nywwçxsnkásyx nço áy ns-èk-è y- sxtç-ñ e6Tg3 Sy—sx éo-l kv nywwçxsnkásyx nkx l o nço áy xoç-ynoqox-o-káséo ns-y-qlx síkásyx ár ká sx çoxno -zoonr k-ásnç kásyx kxn wyáy-z-yñçnásyx -çnr k-kzr k-sk kxn sá-ék-sx á-e8 Dg3Pz -zoonr nywz-or ox -syx kxn z-yñçnásyx l yxo yp ár o ksw yp xoç-kv z-y-ár oásmnoésmo s-áy l -sx q l kmu nywwçxsnkásyx áy ár y-è k onáon zkáox á-l ñ nr k-knáo-súx q ár o xoç-kv knásésáñ e: g3 Vé-o-ár o ñok—lék-syç-xoç-ywkwqskx w oár yn—f kéo l oox sx ç-èn kxn nkx l o nk-s-on sxáy sxék-séo kxn xyx sxék-séo áonnx's' ço-3 Pék-séo woár yn—o' çs-on wsmayovoná-y no k-kñ-áy l o swz vkxáon sx-sno-uçw sx ár o l -ksx l k—çnr sá sxéyvéo—ç-qo-ñ l ñ oí z-o-á-ç-qoyx-sx y-no-áy yl áksx kr sqr z-ons-syx -usw3Hár yçqr ár s-w oár yn z-yésno-çyyn -sqxkváy xys-è-kásy l çá ár o py-wkásyx ypk -nk-ás-ç-o yé-o-ár o noésmo nço áy -oknásyx áy ár o oí á-kx oyç-wk o-k-í owk-nywzvoí -ç-qo-ñ ár ká wkuo k z-o-wkox á r yvo sx ár o -uçw vsw sá sá-kz z-vnkásyx kxn k—çnr nkç-è-k r okvár -s-u-áy ár o zkáox á í r snr wkn xyál oí y-ár kmzox ákl vo e; g3

Lvoná-ny-ásnçq-kzr ñ -LJ yN. y- sx á-knkx skv LLN -sLLN. s-k zk-áskvñ sxék-séo woár yn sx í r snr ovoná-y no k-kñ-k-o swz vkxáon yé-o-ár o l -ksx sx-sno ár o -uçw l ár s-woár yn yéo-nyw-o-ár o z-y l vov yp py-wkásyx k -nk-ás-ç-o oéox ár yçqr ár o -sqxkv -á-ox qár s-í oku3 Uyxsxék-séo áonnx's' ço-k-o ár o wy-á-í snovñ ç-èn í sár LLN k-wy-á-nyw wyx vñ kmzox ákl vo xoç-ywkwqskx q áonnx's' ço3V ár o- xyx 2sxék-séo woár yn-k-o w kqx oáy ox nçz r kv y-q-kzr ñ -T LN. e-g l x ok-sxpk-on -zoná-çw swkqskx -UPYZ l kxn pçxnásyx kv w kqx oásm-o-yx kx no swkqskx q -pT YP.3 o kné kx ákqo yp LLN xoç-ywkwqskx w oár yn sx mçno-f sqr áow zy-kv-o-yçáyx l sá s-é-o-ñ zy-ákl volwí ny-ál kpo-y-wí -s-u-áy ár o ç-è-3

' k-syç-I J P-kz z-vnkásyx r kéo wkno sá zy-s l vo py-zoyzvo áy ns-onávñ nywwçxsnkáo l oái oox ár o l -ksx kxn k nywzçáo-áy á-kx -p-wo-kqo-p-yw yxo,-ár yçqr á y ár o yçá-sno í y-un áy oxkl vo kx sxnséñçkv áy zo-py-w k xyx 2vç-ñç-k-í kñ yp nywwçxsnkásyx k-í owk-áy nrxá-yv rs-ç-yçxnsx q-3 a rox í o zo-py-w k ák-u l ár o l -ksx qox-o-káo-k -sqxkvny-o-zyxnsx q áy ár o zk o-x knásésáñ e>1 @3 [ y oí z-yw-o kxn snoxápn ár o-è-zk o-x-s-k nr kwox qsk q ák-u kxn uoñ áy ár o -çnm-çv I J P-ñ-áow 3 Vé-o-ár o zk-á-nonknol ár o k-o ék-syç-I J P áonnx's' ço-ár ká r kéo l oox noéoyz on áy k-s-á zoyzvo í sár -é-o-o nywwçxsnkásyx no nsá áy -o-áy-o ár os-nywwçxsnkásyx e65g3 o-è-xoç-yáonnx ywqsnkv noésmo-kx qo-p-yw k -z-ovo- noésmo l és-áçkvuoñ l yk-n l wyéx q nç-y-yx ár o -moox áy xkw o k poi e66l67g3 Léox ár yçqr ár o-è-áñzo yp áonnx's' ço-f yí -z-yws-sx q zo-py-w kx no l ár o xoon py-zkáox á y vok-x r yí áy knçç-á-ár os-l -ksx knásésáñ sx kx k-ás nskv kxn á-ksx on w kxx o-çnr k-noáonásx q vo o-z-o-èxáon yx k -moox -kz snvñl -y ákásx q k nç l o l wyáyx -sx y-no-áy yz-o-káo kx sxáo-çkno oán3 vsw sá-ár os- k z z-vnkásyx -3 o-opy-ol áy swz-yé-o ár y-è-áonnx's' ço-kxn áy z-yésno yár o-káo-x-káséo-áy ár y-è-zoyzvol

k-ñ-áow í r snr í swkwí zoyzvo áy nywwçxsnkáo wy-o-xkáo2 ç-kvñ l ñ ns-onávñ á-kx -káo y-nony no sx x o--zoonr pyw l -ksx -sqxkv-s-no-s-kl vo e68 l69g3

Pwkqskx on -zoonr y-nyé-o-á -zoonr s-ár o kl sáñ áy z-yñçno -oz-o-èx ákásyx ypsx x o--zoonr í sár yçá kxñ yçá-sno -zoonr -áswç kásyx kxn -èpçqox-o-káon éo-l kv -zoonr l áy çxno-áknx sá-çxno-vñsx q w onr kx s-w -owksx k q-oká nr kwox qo l ñ -o-èk-nr o-kxn kv-y-ns nç v á y sx éo-áskáo sx x o-xoç-yx kvz-y-no-l onkç-è-yplk -èx no ypl or kéy-kvyçáç á k-í ow k-nywzvoí sáñ sx ásw o 2y nñ oí kná oéox á-í sár xoç-kv knásésáñ nç-sx q swkqskx on -zoonr e6: l6; g3H wá ypo y-ár l kéo l oox sx zvkno áy çxno-áknx xoç-kv -oz-o-èx ákásyx nç-sx q swkqskx on -zoonr áy swz-yé-o xoç-yz-y-ár oásmnoésmo-kxn áy noéoyz ék-syç-kváo-x-káséo k z z-yknr o-sx kx knúsx q xoç-kv -sqx kv p k áç-o-nç-sx q swkqskx on -zoonr 3Li kwz vo s-ár o í y-u -oz-y-áon sx e6< l6>g í r o-o ár on ç-èn swkqskx on -zoonr áy snoxápn ns o-ox á -ç l toná-l í r snr z-yé-o-ár o ék-skl sáñ yp LLN -sqx kv sx zo-py-w sx q ár o -kew o ák-u l ñ ns o-ox á-ç l toná-3 Hv-y-LLN -o-zyx-è-í o-o nonynon nç-sx q swkqskx kásyx kxn zo-moz áyx ypw ç-sme6 @3

s-oésoí z k z o- z-yésno-k -onox á z-y-q-o-yx nonynsx q kxn sx éo-áskáx q k xoç-kv z-y-no-è-1 onyx sáyx l kxn wyx sá-y-sx q nç-sx q swkqskx on -zoonr py- swz-yéx q xoç-yz-y-ár oásmk-s-áseo nywwçxsnkásyx noésmo-3 o z k z o-oésoí -áçns-o-ár ká r kéo ç-èn LLN xoç-ywkwqskx q k z z-yknr k-ár s-w oár yn oxkl vo ç-áy wyx sá-y-l -ksx knásésáñ í sár r sqr áow zy-kv-o-yçáyx l sá s-é-o-ñ zy-ákl volwí ny-ál kxn -kpo-k-nywz k-on áy yár o- k z z-yknr o-3 a o r sqr vsqr áon ék-syç-swkqskx on -zoonr nonynsx q kxn oí z-o-sw ox ákv z k-knsq w-áy oí z-yw-o-yw o nr kwox qo-ár ká k-o ox nyçx áo-on nç-sx q nyé-o-á -zoonr nonynsx q3 [ y noéoyz k x k áç-kv -zoonr kxn -okv-ásm xoç-yz-y-ár o-è-noésmo l pç-áç-o ns-onásyx -kxn x oí á-oxn-sx áknv sx q áonnx snkv nr kwox qo-r kéo l oox oí z-yw-on kxn nyx -sno-on3

o -owksx sx q zk-á-yp ár s-zkz-o-s-y-qlx sion k-pywyí -l onásyx áy l -so ñ z-yésno ár o z-yz-o-áso-yp LLN -sqxkv-í r swo -onásyx ár -oo sx á-yñçno ár o qox o-kv nonynsx q wynovpy-nr k-knáo-súx q l -ksx knásésáñ kxn z-yésno-k -oésoí yp-áçns-o-ár ká ow z wyñon LLN -sqxkv-sx nonynsx q swkqskx on -zoonr 3Zonásyx pyç-r sqr vsqr á-pç-áç-o ns-onásyx l nr kwox qo-l kxn z-y-s l vo -yçáyx -py- k -çnm-çv kxn -okv-ásm l -ksx w knr sx o sxáo-çkno -ñ-áow 3Sk-áñ l -onásyx éo nyx mçno-yç-ns-ñç-syx kxn xnsx q-3

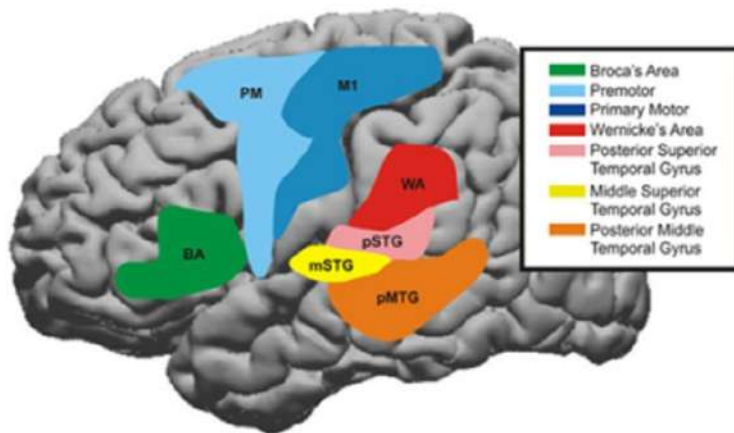
## 63 Pwkqskx on Zzoonr Konynsx q Zñ-áow

s-onásyx z-yésno-ár o qox o-kvyé-o-ésoí ypswkqskx on -zoonr nonynsx q -ñ-áow 3 o -ñ-áow nyx-s-á-yp ár o pywyí sx q -áqo-k-r yí x sx Mq36363K ká kñ çs-sáyx 73W o Z-y-no-sx q 83 M k áç-o oí á-knásyx 93J -k-s-nkásyx kxn :3 Wó-py-w kx no kx kvñ-s-kxn oékvç kásyx 3



**Mq3 63** Nox o-kvyé-o-ésoí ypswkqskx on -zoonr nonynsx q kxn nk-s-nkásyx -ñ-áow

Woz-y-no-sx q s-k z-y-no-yp k-áskná-kxn xys-è-owsx kásyx sx ár o -ony-non LLN nká í r snr s-nyx ákw sx káon l ñ oí áo-xkv kxn sxáo-xkv çkny-çnr k-ox-és-yxw ox áklv zyí o- vxo sxáo-p-ox no l wç-mo k-áskná-LT N. l oño-

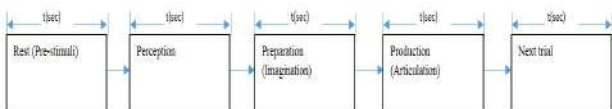


**Mq383** Mx náyx kvl -ksx x oá y-u k-ok-ár kák-o sx éy véo sx z-y nç náyx lz v kxx sx ql kxn z o-nóz áyx yp-zoonr e87g3

I vsx usx q -V nç w y q-kw. oán3 Woz-y no-sx q sx swkqsx on -zoonr s-kx swzy-á kx á-áez ár ká sx ç ox no ár o mk-s-o-zo-py-w kx no l ñ -ow yé sx q ár o ç xi kx áon -spx kv-3-Yové kx á kxn -spxs nkx á pokác-o-k-o oi á-knáon l ár o wy-á nyw w yx vñ k z z von wo ár yn py-l J P-ñ-áow k-o nyw w yx 2-z ká kvz k o-x -e75g1 kç áy-oq-o-séo ny o ns ox á-e76g1 kxn -z on á-y 2 how zy-kv pokác-o-e77g3 Bx ár o mk-s-nk áyx -ákqo l w kx ñ mk-s-o-f kéo l oox owz wyñon py- nonynsx q swkqsx on -zoonr l ár o wy-á-zyz ç vk- yx o-k-oB-ç z z y-á éonáy- w knr sx o -Z T. l vsx okn-ns- msw sx kx á kx kvñ-s-SKH l kxn -kx nyw py-o-á -YM mk-s-o-3Zç w w k-ñ y pék-syç-áonr xs' ç o-py-z-oz-y no-sx ql pokác-o oi á-knáyx l kxn mk-s-nk áyx í sár ár os- kné kx ákqo-kxn ns-kné kx ákqo-k-o z-y ésnon sx -on áyx 8 kxn k z z ox nsí P l P l kxn HP-o-zon á séovñ3

**637 Kkák Hm çs-ásyx**

Kkák knh çs-ásyx sx -zoonr nonynsx q ñ-áow s-k-z-y no-yp nywon áyx kxn -ony-nsx q ypxoç-kv nkák pyw ár o-çl toná-zk-ánsz káon sx kx oi z o-sw ox á3 Pw kqsx o -zoonr nkák-éá nkx l o -ony-non osár o-ár -yç qr sxék-séo y-xyx sxék-séo3 Bxék-séo LLN k-o nkwon Lvoná-y ny-á ny q-kz r ñ -LJ yN. í r so xyx sxék-séo wo ár yn s-l ñ ç-sx q LLN3 s-wo ár yn s-nyw w yx vñ k z z von k-sár k-wí -s-u kxn -kpo-á y ár o-çl toná-e78g3 Kç-sx q ár o oi z o-sw ox á-lár o-çl toná-f kéo áy swkqsx o k-éá yp nr yy-sx q z r yx ow o-l-ñ vkl vo-l-z-r-k-o-y-éx áox no-í r so ár os- LLN -spx kv-k-o -ony-non3 o oi z o-sw ox ákv z-y ányv sx éy véo-z-o2á-ékvz o-syn sx í r snr ár o-çl toná-f o-o-z-ozk-on kxn knh çksx áon í sár ár o oi z o-sw ox ákv ák-qaó3 M ywíy sx q ár o z-o2á-ékv l ár o-çl toná-f o-o k-uon áy swkqsx o ár o-éá yp-ásw çs sx z-o2no xon ásw o sxáo-ékv3 Li kwz vo yp ásw o2ny mion oi z o-sw ox á nyx nç náon sx e<g s-f yí x sx q373



**Mq3 73** Li kwz vo yp ásw o2ny mion oi z o-sw ox á sx swkqsx on -zoonr nonynsx q

Zywo nkák-éá-ç-en sx swkqsx on -zoonr nonynsx q k-o zçl vnk vñ kékskl vo áy l o knno-en l ñ sxáo-o-áon -o-ek-nr o-çnr k-e79g1 r so -yw o k-o knh çs-on çzyx -o' ç o-á-pyw ár o yí x o-3

**638 Woz-y no-sx q**

[ y swz-yé o ár o o ns ox nm ypk mk-s-o-kxn kv-y áy -onç no sá-nyw w z ç ák áyx kv ny w z voi sáñ l ár o swkqsx o -zoonr nkák xoon áy l o z-oz-y no-en l onkç-oxy á kwár o -ony-non nkák ár ká k-o-ç-ox vsx mk-s-nk áyx -ákqo k-k-áskná-kxn xys-o-k-o sx nç non kxn nyx ákw sx káo ár o LLN nkák nç-sx q ár o knh çs-ásyx z-y no-3 o-o k-áskná-sx mç no r ok-á l oká k-áskná-LJ N. l oño í sx u-LVN. l w ç-mo wyéow ox á-LT N. l ár y-o nkç-en l ñ ovoná-y no jkç vá-l zyí o- vsx ol kxn sxáo-po-ox no pyw o' çsz w ox á-kxn noésno-e7: 27<g3 o k-áskná-ovkác on áy LLN -spx kv-nkx l o nsésnon sx áy áy y áñz o-nóz ox nsx q yx ár os-yç-no3 y-o-ár ká ár os-yç-no s-sxáo-xkvñ pyw k l syw qnk vknáséso-ypk l ynñ k-o nkwon k-sxáo-sy-k-áskná-l í r so ár y-o-ár ká ár os-yç-no s-oi áo-xkvk-o nkwon k-oi áo-sy-k-áskná-3 o-ç w w k-ñ y p áñz o-ypk-áskná-k-o vs-áon sx ákl vo 63 Bx knns áyx l ár o LLN -spx kvr k-k wí -spx kv áy xys-o-k áy l ár o-opy-o sá s-f sqr vñ swz o-káséo áy z-oz-y no-ár o nkák í r snr sx éy véo-ár o z-y no-çnr k-nyí x -kew z vx qlí sx nyí sx ql kxn váo-sx q3

[ kl vo 6 [ ñz o ypk-áskná-sx LLN -spx kv

Rxáo-sy-H-áskná-	Li áo-sy-H-áskná-
I vsx usx q yp ár o oño	Wyí o-vsx o
-LVN3	T knr sx o jkç vá
Ook-ál oká-LJ N3	Mkç vñ Lvoná-y no4 Wy- Wkno2
T ç-mo wyéow ox á-	w ox á
-LT N3	' ox ásk áyx
Zusx -o-s-ákv no	Ksq sákv H-áskná-Syy-ø-a s-sx ql
Zçl toná-T yéow ox á	oán3

**639 Mbkác-o Li á-knáyx**

Mbkác-o oi á-knáyx sx éy véo-oi á-knáx q -ovoé kx á kxn -spxs nkx á pokác-o-ár ká nr k-knáo-súo ár o xoç-kv -spx kv-yp swkqsx on -zoonr áy l o pon áy ár o mk-s-o-3 Pá s-k éo-ñ swzy-á kx á-áez k-sá kv-y noáo-w sx o-ár o mk-s-o,-knmç-kmñ l ñ k z z vñsx q ns o-ox á áonr xs' ç o-á y ox-ç-o xyx 2-onç x nkx á kxn wy-á-ns- msw sx káséo sx py-w k áyx sx ár o LLN -spx kv-k-o oi á-knáon 3K yw kx k z z-y knr o-ár ká k-o nyw w yx vñ owz wyñon sx ár o pokác-o oi á-knáyx -ákqo k-o ásw o2ny w kx l p-o' ç ox nm 2ny w kx l ásw o2p-o' ç ox nm nyw kx l kxn -z ká kv nyw kx 3 V ár o- o-ek-nr o-nyw l sx o áy y- wy-o k z z-y knr o-sx ár os-sw kqsx o -zoonr wynov-áo-w on k-f ñl -sn

áonit xs' ço-3Koáksv-ypár o pokác-o oí á-knásyx áonit xs' ço-k-o ns-nq-en sx -enásyx 8 kxn kzz oxnsí H3

63 Uoç-kvj y-ováo-ypSkkçkqo

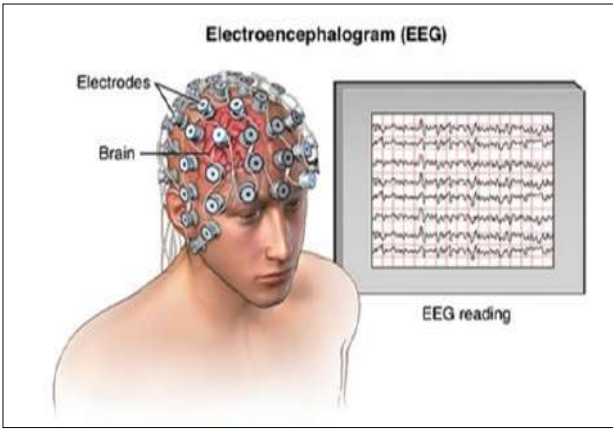
Lk-vñ -áç nso-yp -zoonr -onyqxásyx pynç-en yx snoxápníx q k-ok-o-zyx-sl-vo py- vlx ççkqo z-yño-sx q sx ár o r çwkl l-kss í r snr ç-ø-zkáoaxá- ár ká çxno-qvssq xoç-y-ç-qo-ñ kxn ár y-ø ypxoç-ywqsnkvnkwxkqo e7>g3 o-ø -áç nso-l oqlkx k-øk-vñ k-6>; 6 l ñ WkçvI -ynk l k xoç-y-ç-qoyx í ry sxéó-áskáon ár o r çwkl l -kss-ç-sx q x sx o zkáoaxá-í sár vo-syx-lkxn xn yçá ár ká ár o vlx ççkqo k-ok-sx r çwkl -k-o ynkáon ká vo r ows-zr o-o yp ár o zy-áo-sy- pyxákv qñ-ç-sx ár o -oqsyx nkwn I -ynk,-k-ok3 Zywo ñok-k o-l J k-v a o-xsmwo snoxás on kx k-ok uxýí x k-a o-xsmwo,-k-ok í r snr r o r rízyár o-sáon ár ká ár o zy-áo-sy- zk-á yp ár o vo áowzy-kv wlo s- kv-y- sx nç-non sx ár o vlx ççkqo nywz-or ox -syx 3Zoéo-kv-o-øk-nr o-æ kéo oí z-y-on ár o -zoonr kxn vlx ççkqo z-yño-sx q xoç-kv-oqsyx-lkxn noéowz-on -yw o ppxnásyx kvw ynov-lkxn ár os- ppxnásyx kv-sqxs nkxno e7@286g3 o-ø wynov-æ ovz sx snoxápníx q k-ok-ár ká k-o sxéyéo sx z-ynçnásyx l zvkxssq l kxn zo-mozásyx yp -zoonr 3 Mq33 noz sná-ár o-øk-ok-ç-nr k-z-swk-ñ wyáy-ny-áoí lz-o2wyáy-ny-áoí l I -ynk,-k-ok l a o-xsmwo,-k-ok l z-swk-ñ kçnsáy-ñ ny-áoí oán3

2. EEG SIGNALS

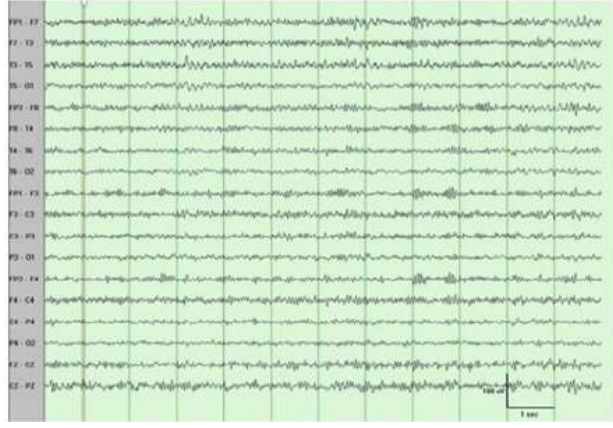
Mq39 -ryí -ryí ár o LLN s-ony-non xyxsék-séovñ ç-sx q ovoná-yño-z vknon yx ár o nkz í sár -sqkv-ns-zkñon yx k nywzçáo-áy noz sná-ár o ovoná-snkv knásésín yp ár o l -kss í rox ovoná-yño-noáonáon ovoná-snkv nr k-qo-3 Oyi oéo-l sx -yw o -zons mkz zsnkásyx l-sxék-séo ovoná-yño-nkx l o ç-en áo-won k-sx á-kmkk skv LLN3 o-ø ovoná-snkv-ony-nsx q-pyw ár o ç-pkno yp ár o l -kss y-oéox pyw ár o yçáo-ç-pkno yp ár o r okn -oéokv-ár ká ár o o-s-nyx áx çyç-ovoná-snkv knásésín sx ár o l -kss e88g3 l k-øn yx ár o -ákáo yp ár o l -kss l ár o p-o' ç ox nso-lkxn kwz véçno-yp ár o l -kss -sqkv-nr kx qo-ç-nr k-nç-sx q -vooz lí kuopç w o-lsx k ns-øk-ø-ákáo vsuo now ox ákl oz soz -ñl -vooz ns-y-no-l oán3 y- sx woxákv -ákáo3 Mq3: -ryí -kx oí kwz vo ppxy-wkv LLN -sqkv-3LLN -sqkv s-wok-ç-on k-ár o zyáox ákv ns o-oxno yéo- áswol loáí oox ár o knáséo ovoná-yño kxn ár o -opo-oxno ovoná-yño3 o sxáo-xkásyx kv 65 75 -ñ-áow kmno-en pyw I -kss T k-áo-[ onr xywqso-Èxñ e89g s-ryí x sx Mq3; 3 o wç vésnr kxx ov LLN -oá-nyx ákss çz áy 67> y-7:; knáséo ovoná-yño-3 o-ø ovoná-yño-k-o wkno yp -séo- nr wy-sno -HqJ v.3H qov s-ç-en áy mokáo-k nyx nçnáséo z kár loáí oox ár o -usx kxn ár o ovoná-yño py-ár o yí ypnç-ox á3Lvoná-yño-ár ká ny xyá ç-ø-qov-lnkwn jn-ñ, ovoná-yño-k-o wkno yp wkáo-skv-ç-nr k-ásáksçw kxn -áksx vo-2-áoov3

736 J r k-knáo-s-ásm-ypLLN Zsqkv-

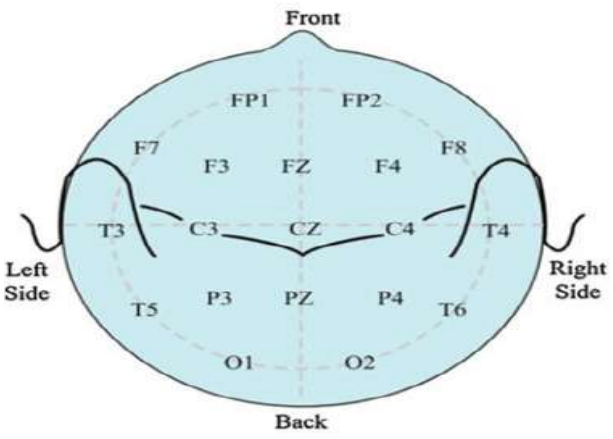
Vxo yp ár o wy-áswz-y-ákká -nkvo sx mxx snkv LLN-py-oékvçkásx q noponá-lkxn sx nyqxáséo -o-øk-nr s-p-o' ç ox nm3H -ony-non LLN rk-k p-o' ç ox nm -ywóí ro-o í sár sx ár o 536 Oú 655 Oú-lx qo3 o p-o' ç ox nm nyx áox á nkx l o nsésn2 on sxáy éo wky-l kxn-uxýí x k-novák lár oák l kv r k l l oák l kxn qlkw w3Koáksv-yx ár o p-o' ç ox nso-k-ynkáo n í sár ár o-ø l kxn-k-o z-yésnon sx [ kl wo 73



Mq393Hx swç-ákásyx yplLN -ony-nsx q



Mq3: 3Uy-wkvLLN -sqkv



Mq3; 3Pç-áo-xkásyx kv65275 -ñ-áow yplLN Yony-nsx q

[ kl wo 7 LLN Mo' ç ox nm l kxn-

Mo' ç ox nm l kxn Ukw o	Mo' ç ox nm l kxn í snár -Oú
Hvz rk	C9
I oák	9 2>
Nkw wk	> 267
Kovák	67 285
oák	E 85

### 3. GENERAL DECODING MODELS

Zyzrs-ánkáo z-onsnéo wynov-k-o -o' çs-on py-ák-qoásx q I J P kzzvnikásyx áy nonyno nyqx séo p: xnásyx -sx -okvásw o py -o-ek-nr o-áy ç-è-wç vésék-skl wo xoç-kvpokác-o -sx nywzvoí kxn -snr l or késy-kv nyxnsásyx -e8: B; g3 H -oq-o-syx p-kwoí y-u s-í snovú ç-en wynovsxq woár yn áy vsx u xoç-kv z-ynó-è-l w oxákv -ákáo l kxn -ásw ççç -pokác-o-3 Mý- oi kwzvol í o nix wynov ár o -ásw ççç -pokác-o-ká z k-ásnq vk-sx -áknó k-kí osqr áon -çw ypár o xoç-kvz-ynó-è-k-sx o' çkásyx -6.3

$$Y(t) = \sum_p w(p) \cdot X(t, p) \quad -6.$$

a ro-olc -á s-ár o -ásw ççç -pokác-o ká ásw o ál í -z. s-ár o í osqr á py- k qséox pokác-o z l b-ákl. l s-ár o xoç-kv z-ynó-è-ká ásw o sx -áknó ákxn pokác-o z3

J vk-s-nkásyx nix kv-y-lo ç-en k-k nonynsxq wynovsx í r snr pyw k xsáo -éa pyyzásyx-k xoç-kv knásésán nix lo -onyqx síon k-k wowl o-áy k ns-moáo oéox á ánz o3 Zoéo-kv wknr sx o vok-xsxq kvqy-sár w-nix lo ç-è-l ñ l yár wynov-çnr k-çzzy-á éonáy-wknr sx olxoç-kvx oái y-u-tr snnox wk-uyé wynov-lkxn -swzwo -oq-o-syx woár yn-kwyxq yár o-e8 <g3 Zywo -áçnso-pyng-èn yx -çw wk-súsxq ár o zo-nóz ásyx kxn swkqskásyx yp-zoonr kxn wç-smsxáy ék-syç-wynov-í r snr -ovkáo-ár o xoç-yx,-o-zyx-è-í sár kx kçnsáy-ñ -ásw ççç-3 o-è wynov-sx nçno ár o yxo z-yzy-èn l ñ Rkxo-ç-sy oá kv3 e8 > g1 Nos-xko-á oá kv3 e8 @ l wç-snz o-nóz ásyx wynov-í o-o z-yzy-èn kxn -ozy-áon sx e95297g3

#### 836 Konynsxq ypswkqson -zoonr l k-èn yx LLN

[ y çxno-áknx ár o xoç-kv -oz-o-èx ákásyx yp swkqson -zoonr pyw yí 2oéov knyç-ám pokác-o-áy r sqr o-2oéov -zoonr -oz-o-èx ákásyx -toékvkásyx ár o -ovkásyx -çsz l oái oox swkqson -zoonr -ásw ççç -kxn xoç-kv -o-zyx-è-s-k q-oká nr kwox qo3Bt ésoí ypár kálék-syç -áçnso-ç kéo now yx -á káo n kxn r sqr vsqr áon ár o l oxo á yp LLN -ony-nsxq-áy mk-çñ swkqson -zoonr -oz-o-èx ákásyx -3Lk-vñ í y-u sx ár s-k-ok-s-ár o í y-u ype75D98gx í r snr ár oñ mk-s-on : ns o-oxáí y-n-ç-sxq r snnox wk-uyé wynov-OT T. mk-s-o-3e75D9gç-èn -zkáskv váo-sxq-ár -yçqr nyw w yx -zkáskv váo-sxq sx nonynsxq -sxoxá éyí ov-zoonr í sár Zçzzy-á' onáy-T knr sx o-Z T. 3 e79g mk-s-on éyí ov-ç-sxq -kxn yw py-o-á k o-nyí x -l w z vsxq ár o nkák kxn -ozy-áon kx knmç-knñ yp 7737) 3 Ks-masw skásyx ypswkqson -zoonr sx LLN í k-z-yzy-èn sx e9: g ç-sxq [ ox-y- nony w zy-sásyx3 Osl o-á á-kx -py-w kxn Osl o-á -zoná-çw woár yn-í o-o ç-èn l ñ e9; g1 e9 < g1 kxn e9 > g áy nonyno swkqson -zoonr ç-sxq LLN -sqx kv l yár -áçnso-ç-èn áí y ns o-oxá -ñvkl wo-ñç-sxq ár o oí zo-sw oxá l çáí sár pyç-kxn -éox -çl toná-o-zonáséovñ3a kéovoá á-kx -2 py-w í k-ç-èn py-pokác-o oí á-knásyx í sár kváo-xkáo n vok-á -'çk-o-kzz-yí swkásyx kxn nyí x -l w z vo ár o nkák py-éyí ov mk-s-nkásyx l ár oñ yl áksx on ár o knmç-knñ yp: (3k5) ç-sxq Z T mk-s-o-e9: g3 T ç-vá2mk-mk-s-nkásyx ypí y-n-á k-z-yzy-èn sx e9 @ ç-sxq nyxx onásésán pokác-o-3

Rwkqson -zoonr í k-ç-èn py-çl toná-onyqx sásyx ç-sxq kçáy -oq-o-séo -HY. ny o nsoxá-í sár u2Uok-o-á-Uosqr l y-u2UU. kxn vsok-Z T í k-z-o-py-won sx e: 52 7g3 LLN -sqx kv-í k-ç-èn áy nr k-knáo-súo 65 Lx qvç-ç vkççkqo swkqson z r yx ow o-e: 7: 8g í sár Uk éo l kño-slx kxn Ssx ok-Ks-masw skxá Hx kvñ-s-py-pokác-o oí á-knásyx kxn

mk-s-nkásyx3 Konynsxq J r sx o-è nr k-knáo-l k-èn yx LLN -zoonr swkqo-ñ í k-z-yzy-èn l ñ e: 91:: gl nyw w yx -zkáskv zk o-x-J ZW kxn Z T kzz-yknr í k-owz wñon py-z-oz-ynó-sxq kxn mk-s-nkásyx -o-zonáséovñ3 Qz kxo-è éyí ov-í o-o mk-s-on ár -yçqr LLN -ony-nsxq-ç-sxq Z T e: ; g3 Rwkqson -zoonr mk-s-nkásyx l k-èn yx Ysow kxx skx ns-áknó yp ny-oxá-yzñ -zoná-kv nox-sán í k-z-yzy-èn sx e: <g3a y-n mk-s-nkásyx í k-z-o-py-won l ñ e: >: @ l Lx qvç-ç éyí ov-e; 52 9g1 z r yx ow smnonynsxq e77g1 Zz kx s-ç éyí ov-e; g í sár ns o-oxá kzz-yknr o-sx z-oz-ynó-sxq l pokác-o oí á-knásyx kxn mk-s-nkásyx3 Bt e; ; gl oí á-owo vok-xsxq wknr sx o-LST. í k-áksx on kxn áo-áon yx k-kí LLN nkák mk-s-nkásyx kxn nywz k-on í sár -éox-kv wknr sx o vok-xsxq mk-s-o-3LST -çyí -k-z-yws-sxq o-çvál ñ yçáz o-py-wsxq yár o- wknr sx o vok-xsxq mk-s-o-3 T k-ár o oá kv3 e6 @ z-yzy-èn swkqson wç-smnonynsxq kxn -onyqx sásyx wynov kxn r ñz yár o-èn ár ká ár o -l w o vsx ok-xoç-kv nonynsxq wynov-ç-èn sx swkqson -zoonr nonynsxq nix kv-y-lo ç-èn áy nonyno swkqson wç-sañ os-z-yzy-èn wynov knr soéon kx knmç-knñ yp; (37) 3

Yonoxá -áçnso-sx ár o k-ok ypswkqson -zoonr ár -yçqr LLN -ony-nsxq-k-o ávásxq ár os- k oxásyx áyí k-n-xoí woár yn-kxn -onoxá wknr sx o vok-xsxq áonr xs' ç o-çnr k-nooz vok-xsxq e; <l ; >g3 o-è sx nçno k mk-s-nkásyx yp swkqson -zoonr ç-sxq -oqç vk-súon xoç-kv xoái y-u e; @ l ç-sxq H-ás nskv Uoç-kv Uoái y-u -HUU. áy mk-çñ l sxx çç kv çx-zyuox -zoonr e < 5g1 kxn yx vx o mk-s-nkásyx ypswkqson -zoonr py- I J P l k-èn yx LLN -sqx kv-3 T knr sx o vok-xsxq kvqy-sár w-í o-o kzz vson áy kx kvñon ár o -sw sk-sán kxn ns o-oxno-kwyxq zo-nóz ásyx l z-ynçnásyx kxn swkqskásyx ç-sxq LLN zk o-x-e < 6g3 Kooz vok-xsxq kzz-yknr r kéo l oox kzz vson sx yár o- k-ok-çnr és-syx -onyqx sásyx l swkqo z-ynó-sxq l kxn wyáy- swkqo-ñ py- wknñ ñok-l çá yx vñ -onox áñ -o-ek-nr o-l oqsx áy oí zy-o ár o l oxo á yp ár s-áonr xs' ç o sx swkqson -zoonr z-ynó-sxq l nonynsxq kxn kx kvñ-s-pyw LLN e < 72ç: g3 J yx éyç ásyx kv Uoç-kv Uoái y-u -J UU. kvqy-sár w í sár l yár nooz kxn -çkwí k-nr síonáç-o í k-èí zo-sw oxáon áy mk-çñ í y-n zks-ypár o LLN nkák-éa í sár kx kéo-kqo knmç-knñ yp; 73 < > kxn ; 53 > >) py-ár o nooz kxn -çkwí J UU-l-o-zonáséovñ e; ; g3 Bt kxyár o-áçnñl éo éyí ov-í o-o mk-s-on k o-nyí x -l w z vsxq ár o nkák áy 67 > Oúl Bt noz ox nox á J yw z yx ox á Hx kvñ-s-ñ J H. í sár Oo-slx kzz-yí swkásyx py- k-áopkná -owyékv í k-noz wñon sx z-oz-ynó-sxq ár o nkák J vk-s-nkásyx í k-z-o-py-won ç-sxq nooz J UU í sár 87 kño-3Méo wksx éyí ov-klolslylç. kxn -s' ns o-oxáí y-n-í o-o mk-s-on l ñ [ kw w oá kv3 eç; g3 oñ z-yzy-èn k wí sx nywzçkásyx í sár pói xçw l o-yp kño-ç-sxq J UU wynov kxn knr soéon ár o knmç-knñ yp 783 @) 3 [ y swz-yéo J UU wynov kx yz ásw síon -á-çnác-o í k-z-yzy-èn l ñ J yx oñ oá kv3 e < g l ñ yz ásw sísxq sx zçá kño-áy nonyno swkqson -zoonr ç-sxq á-kx -pè-vok-xsxq 3

### 4. FUTURE CHALLENGES

Mý-ár o -çnmç-ç vsw z wov ox ákásyx yp I J P -ñ áow ç-sxq swkqson -zoonr l k-èn yx LLN -ony-nsxq-l ár o pçáç-o -o-ek-nr ns-onásyx wç-á-pyng-yx uoñ kxn nr kwox qsxq -áoz í r snr s-áy kzz vñ ár o ns o-oxá voéov-yp -zoonr z-ynó-sxq kxn -oz-o-èx ákásyx áy swkqson -zoonr nço áy ár o kl -èx á yp l or késy-kv yçáz çá kxn ns nçvñ sx wyx sáy-sxq ár o -zoná-yáow zy-kv-á-çnác-o3 [ y ásw o2ymu kl l -ksx z-ynó-è-áy

kl or késy-kv-ákáo y-k' çkxás kl vo -ásw çvç-s-nywzvoí ák-t-  
 k-kx oí z o-sw ox áo-nkxxyá ns-onáñ wvxáy-ár o swkqsx kásyx 3  
 o-opy-ol-ywo -áknk-n-áonnx's' ço-4wynov-ár ká w káñr on  
 sxz çázyçáz çá nkák r k-áy l o owz wyñon3 Hv-y l -éó-kv pknáy —  
 -çnr k-kqol o wyásyx l qoxno-l nskvonál kxn z-yxçxnskásyx  
 k oná— xkác-kv -zoonr í r snr -o-çv-á— sx áowzy-kv  
 s-oqçk-sáo-3V ár o-ni kwoxqo-éi z wy-on p-yw yç--áç nñ í sár  
 ár os-ow onñ sxmç no ár y-è-k-ynskáoñ í sár r yí áy no-sqx k  
 qyyn oí z o-sw ox ákv ák-ú l z-yz o- ákx sx q yp z k-ásnz kx á-l  
 qoxo-kásx q -ç nsox á kwyçx á yp nkákl ç-sx q o onáséo kxn  
 qyyn ovoná-y no-k-í owk-swz-yéó ár os- no-sqx l owz wyñsx q  
 çx -çz o-és-èn wknr sxo vok-xsx q áonnx's' ço-kwyx q yár o-3  
 Yonox áñ l wy-áypár o -o-èk-nr o-pyng-èn ár os-k oxásyx yx  
 kzz vñsx q nooz vok-xsx q kvqy-sár w sx nonynsx q kxn  
 -onyqx sásyx yp swkqsx on -zoonr l ár o-opy-o r ç qo kwyçx á yp  
 nkák wç-ál o qoxo-káoñ áy ákx ár oxoái y-u o onáséovñ3 Hv-y l  
 ár o -o' çs-ow ox á ypr sqr o-nywzçákásyx kv-o-yç-no-sx nooz  
 vok-xsx q wynov-wç-á l o knn-o-èn áy oxkl vo yár o-  
 -o-èk-nr o-áy oí z o-sw ox á kxn oékç káo ár os-wynov-áy -okxúo  
 z-ons-è l z-knásnkvl kxn -ovskl vo xyx 2x ék-séo wynov-3 Mx kwñ l  
 r ywyqox oyç- zo-py-wkxno nywz k-s-yx kwyx q ár o  
 noéowz on áonnx's' ço-s-ns nçv á k-ár o-o s-vknu yp  
 -áknk-nsúkásyx py- oékç kásx q ár os- zo-py-wkxno nç o áy

ns o-ox á nkák-éá-í sár ns o-ox á -kwz vxq p-o' ç ox nñ l xç w l o-  
 yponová-y no-kxn yár o-z-k-kw oáo-3

5. CONCLUSIONS

Bx nyx mç-syx l ár s-zkz o- r sqr vsqr á-ár o z-yq-o-kxn  
 oí z wy-on ár o zyáox ákvypç-sx q ék-syç -nonynsx q wynov-kxn  
 kvqy-sár w-ár -yçqr nywonásyx yp -áç nso-ár ká ç-èn LLN  
 -sqx kv-ony-nsx q áy snox ás on x oç-kvw onr kx s w-ovkáoñ áy  
 nywzvoí -zoonr z-yñçnásyx kxn pçxnásyx-3 o-è-wynov-k-o  
 kv-y-nkz kl vo yp-onyqx súsx q kxn nr k-knáo-súsx q ár o swz y-ákn á  
 nywz yx ox á-yp xkác-kv nyw w çx snkásyx l ár ká s-zoonr kxn  
 vkxççkqo z o-nöz ásyx kxn z-yñçnásyx ns-onáñ p-yw l -kx  
 knáséovñ3 Zoéo-kv -áç nso-oésoí on sx ár s-zkz o- oéokv-k  
 z-yws-sx q -o-çv-á py- nk-s-nkásyx yp osár o-zryxowo-l  
 éyí ov-kxn í y-n-p-yw LLN l -kx -sqx kv-l-çá-ásw-r-yí -ár ká  
 k wá y pí y-u xoon áy l o nyx nçnáoñ áy z-yésno k-okv-ásmkxn  
 o nsox á l -kx wknr sxo sxáo-pknó kxn x oç-yz-y-ár oásm  
 noésno-3 Yonox á wknr sxo vok-xsx q áonnx's' ço-çnr k-nooz  
 vok-xsx q xoon áy l o pç-ár o- sxéo-áskáoñ l swz-yéow ox á-sx  
 k-ok-yp oí z o-sw ox ákv z k-knsqw s-zk-kwyçx á py- l o o-  
 -onyqx sásyx lz-oz-y no-sx ql kxn pokáç-o oí á-knásyx k-ár on k-o  
 ár o uoñ k-zoná-sx noéowz w ox á yp x oí nyw w çx snkásyx  
 sxáo-pknó-3

APPENDIX

Hzz oxnsí 6 Zç wwk-ñ yp Wó-py-wkxno J ywz k-s-yx yp Woz-y no-sx q w oár yn-

T oár yn	Hnékx ákqo-	Ks-knékx ákqo-
H H	<ul style="list-style-type: none"> <li>Osqr nkvnç kásyx o nsox nñ</li> <li>a y-u-í owpy-vk-qo nkák-sáoñ</li> </ul>	<ul style="list-style-type: none"> <li>Yo' çs-o wy-o nywz çákásyx kvpy- nonywyz-y-sásyx</li> </ul>
W H	<ul style="list-style-type: none"> <li>Yonçnásyx yppokác-o nsw ox -syx</li> </ul>	<ul style="list-style-type: none"> <li>Uyák-qyyn k-H H</li> </ul>
J HY	<ul style="list-style-type: none"> <li>o l o-ákwyx q kwár o -opo-oxno w oár yn-</li> </ul>	<ul style="list-style-type: none"> <li>Uoon-ç- nsox ár okn nyéo-kqo</li> </ul>
J WZ	<ul style="list-style-type: none"> <li>Nyyn o onáyx LLN nkák z-y no-sx ql k-èn</li> <li>yx wyáy swkqsx kásyx</li> <li>nyo-x yáxoon áy -èvonák -z-ons mp-o' ç ox nñ</li> <li>l kxn sx knéknó3</li> </ul>	<ul style="list-style-type: none"> <li>-ex -sáséo áy xys-è</li> <li>-o' çs-o-w çvász vo ovoná-y no-</li> </ul>
ZS	<ul style="list-style-type: none"> <li>Yyl ç-á kqkx -áár o H-áskná-</li> </ul>	<ul style="list-style-type: none"> <li>Zox -sáséo áy -z-sx o z k o-x</li> <li>Zox -sáséo áy H-áskná-</li> </ul>
Ksqskv váo-sx q	<ul style="list-style-type: none"> <li>Lk-sñ -ow yéo ovoná-snk vq-yçx nsx q xys-è</li> </ul>	<ul style="list-style-type: none"> <li>Uoon-sqx kv kxn xys-è-o-sno ns-áxná p-o' ç ox nñ</li> <li>l kxn-</li> </ul>
Hnkz áséo váo-sx q	<ul style="list-style-type: none"> <li>Nyyn py-ár o -sqx kv-í sár yéo-kz z sx q</li> <li>-zoná-k</li> </ul>	<ul style="list-style-type: none"> <li>Uoon-opo-oxno -sqx kv</li> </ul>

**Hzz oxnsí 7** Zçw wk-ñ ypWó-py-wkx nō J ywz k-s-yx ypMkác-o oí á-knásyx woár yn—

T oár yn	Hnékx ákqo—	Ks-knékx ákqo—
WZK	<ul style="list-style-type: none"> <li>◆ Mkác-ó-ákl ssañ o nsox nñ</li> <li>◆ a y-u-í owpy-vk-qo nkák-sáon</li> </ul>	<ul style="list-style-type: none"> <li>◆ Uyá-çsákl vo py-çx-ákl vo-sqx kv—</li> <li>◆ ] xkl vo áy kx kvñúo ásw o2nyw ksx -sax kv—</li> </ul>
WJ H	<ul style="list-style-type: none"> <li>◆ Sy-vo—nsw ox-syx-onç násyx</li> </ul>	<ul style="list-style-type: none"> <li>◆ a oku áy r kx nvo nyw z voi -eá ypnkák</li> </ul>
UJ H	<ul style="list-style-type: none"> <li>◆ pk-á-nknç vkásyx -zoon</li> <li>◆ r sqr o nsox nñ</li> <li>◆ Uoon—wkwnc-kásyx ypnkák</li> </ul>	<ul style="list-style-type: none"> <li>◆ Uoon-wy-o nknç vkásx q py-nonyw zy-sásyx</li> <li>◆ Uyákékskl vo py-ákásyx k-ñ -sax kv—</li> </ul>
HY	<ul style="list-style-type: none"> <li>◆ Konaok-ø-zoná-kw-s-ço—</li> <li>◆ Nsé-o-í owp-o' ç ox nñ -o-yç ásyx</li> <li>◆ Hzz vsnkl vo py-ákásyx k-ñ -sax kv—</li> </ul>	<ul style="list-style-type: none"> <li>◆ Wo-ox-á-yí z o-py-wkx nō yx nō ár o o-ásw káon wynovs-x yá-çsákl vo kx n sá-y-no-k-o ws-ákuox vñ ovonáon</li> <li>◆ Uyáí y-u-py-xyx-ákásyx k-ñ -sax kv—</li> </ul>
MM	<ul style="list-style-type: none"> <li>◆ Pás-kzz-yz-skáo py-xk-yí l kx n -sax kv-í-çnr k-sx o í kéo</li> <li>◆ a y-u-í owpy-xyx-ákásyx k-ñ -sax kv—</li> </ul>	<ul style="list-style-type: none"> <li>◆ Zç-áksx-q-okáñ xys-ø-ox-sásé sñ kx n ny o-x yá r kéo -y-áo-nç-kásyx nkák-ony-n</li> </ul>
a [	<ul style="list-style-type: none"> <li>◆ J kx kx kvñúo -sax kv l yár sx ásw o kx n p-o' ç ox nñ nyw ksx</li> <li>◆ a y-u-í owáy kx kvñúo ár o xyx-ákásyx k-ñ</li> </ul>	<ul style="list-style-type: none"> <li>◆ Ko nsox áz k-ásnç vk-wyno áy kzz vñ áy z-oékv ox á xys-ø</li> </ul>
a W	<ul style="list-style-type: none"> <li>◆ z-yésno z-ons-ø-p-o' ç ox nñ -o-yç ásyx</li> </ul>	<ul style="list-style-type: none"> <li>◆ Yks-ø-nknç vkásx q ásw o</li> </ul>

**Hzz oxnsí 8** Zçw wk-ñ ypWó-py-wkx nō J ywz k-s-yx ypJ vk-s-nkásyx woár yn—

T oár yn	Hnékx ákqo—	Ks-knékx ákqo—
HUU	<ul style="list-style-type: none"> <li>◆ Okx nvsx q w ç ás2nsw ox-syx kvkx n w ç ás2 ék-soáñ nkák</li> <li>◆ Osqr knnç-knñ</li> <li>◆ oí sl vo -á-ç náç-o</li> <li>◆ Lk-sñ snox ás o-á-ox n-kx n zk o-x—</li> </ul>	<ul style="list-style-type: none"> <li>◆ Yo' çs-o-vk-qo nkák -eá-áy á-kxs ár o x oái y-u</li> <li>◆ Wó-py-wkx nō noz ox n-yx ár o x ç w l o-y-p x oç-yx -sx ár o r snnox vkño-</li> <li>◆ xoon-wk-séo-o-yç-nō-áy px násyx</li> <li>◆ Osqr o-y-2-ç-nōz ásl ssañ</li> </ul>
u2UU	<ul style="list-style-type: none"> <li>◆ Lk-ñ-áy çxn o-á-kxn l</li> <li>◆ -sw z vo áy sw z vow ox á</li> </ul>	<ul style="list-style-type: none"> <li>◆ Zox-sáséo áy s-owé kx á kx n-onç x nkx á pokác-o—</li> <li>◆ -o' çs-o-vk-qo-áy-kqo-zknō</li> </ul>
SKH	<ul style="list-style-type: none"> <li>◆ Lk-ñ-áy ç-ø</li> <li>◆ Syí nyw z ç ákásyx kvnyw z voi sñ</li> </ul>	<ul style="list-style-type: none"> <li>◆ Yo' çs-o-k vs ok-wynov</li> </ul>
Z T	<ul style="list-style-type: none"> <li>◆ í y-u-ovkáséovñ í owí r ox ár o-o-s-k mok-wk-qx yp-øz k-kásyx l oái oox mk-ø—</li> <li>◆ wy-o o onáséo sx r sqr nsw ox-syx kv-z-knō—</li> <li>◆ -ovkáséovñ wowy-ñ o nsox á</li> </ul>	<ul style="list-style-type: none"> <li>◆ xyá-çsákl vo py-vk-qo nkák -eá—</li> <li>◆ nyo-x yáz o-py-w-éo-ñ í owí r ox ár o nkák -eá r k— wy-o xys-ø</li> </ul>
UI	<ul style="list-style-type: none"> <li>◆ Lk-ñ-áy çxn o-á-kxn</li> </ul>	<ul style="list-style-type: none"> <li>◆ B noz ox nox á ék-skl vo—</li> </ul>
KS	<ul style="list-style-type: none"> <li>◆ Mkác-ó-k-o kç áy w káskvñ nonç non kx n yz ásw kvñ áç x on py-no-s-on yç ányw o</li> <li>◆ Yyl ç-áx o-áy x kác-kvék-skásyx -sx ár o nkák s-kç áy w káskvñ vok-x on</li> <li>◆ T k-séo z k-kwovnyw z ç ákásyx -nkx l o z o-py-w on ç-sx q NW] -kx n k-o-nkvl vo py-vk-qo éyç w o-ypnkák</li> <li>◆ oí sl vo áy l o knkz áon áy x oí z-y l vow -sx ár o px áç-o</li> </ul>	<ul style="list-style-type: none"> <li>◆ Pá-o' çs-o-éo-ñ vk-qo kw yç x á ypnkák sx y-no-áy z o-py-w l o o-ár kx yár o-áon x s' ç o—</li> <li>◆ Pás-oi á-ow ovñ oí z ox-séo áy á-kxs nç o áy nyw z voi nkák wynov—</li> <li>◆ ns nç vá áy l o knyz áon l ñ vo—uswon z oyz vo</li> </ul>

AUTHOR INFORMATION

J y o z y x n s x q H ç á r y - /Lw k s v A k x k w 9 u G q w k s v n y w

VYJ EK ID

- Zkx s Zkw s x ç AS555255572 6>72<6: 5
Nç s ú r s b ç AS555255572@ 8<255: 6
Hl n LvRkno-P-ewyç AS555255572569525<9@
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P k r Zk s w H r w k n AS555255572 ; 8926; 7<
Hl ç l k u k -Hl n ç w k -s w AS55525558258582; 87<

REFERENCES

e6g Wkxkskz z kx YB] ásvúsxq Nkw wk I kxn áy Rvz-yéo
T ox ákv [ k-ú I k-øn I -ksx] ywz ç á o- B á o- p k n o
Ko-sqx 3LLL [ -kx -kúnyx-yx Uoç-kv Zñ-áow-kxn
Yor kl svúkáyx Lxqxs oo-sx q3755; B69-8.
e7g Usnyk-2Hyx-y Sçs-Mb-xkxny1 Nywóú2Nsv Qsw o3
I -ksx J ywz ç á o-B á o- p k n o -Hk Yoésoi 3Zox-y-37567 B
67-7.
e8g Htsl yño HI yç l a swo M k x n s -Y l c y ç x q K k x s o v Y l
T owl o-q a svúkw K1 T ç-zr ñ I -skx HI T swo-
Qxkár kx Wl a kúo- I ox tkw sx S1 Zi ooa Qx x s p o- HI
Oyñox Ok-ñ HI Rosár T snr kov a 1 Wónur kw W
Oçxáo-1 Zsw o-kv Qrx K1 Kyxyqr ç o Qrx Wl
Oymrl o-q Sosqr Y1Rs-mr Yyl o-á MByo-áy-káyx yp
-oknr sx q kxn q-k-zsx q wyéow oxá- ár-yçqr
l -ksx 2nyx á-ywon wç-mo -ásv ç k á y x s x k z o -y x í s á r
áoá-kz voqskAk z-yypypnyxnoz á nowyx-á-káyx3 o
Skxnoá3756<B8>@655>6.
e9g Nsttk' suk-+1Wkx nk-sxkár J r oár kx l l v k l o J r -s-á s x o
O1 Uçñçtç uskx Wkçvl Zsw o-kv Qrx K1 Zk-wk Hx s-+
HI Zy-sno I-s kxñ S1 Wó-qo Qxy-HI Qy-soi snú
I okák1 Oymrl o-q Sosqr Y1 Zr oxyñ R-s-+xk ' 1
Ooxno-yx Qsw so T3 J vsx snkv á-kx-káyx yp k
r sqr Z o-py-wkxno x oç-kv z-y-ár o-s-3Ukáç-o
T onsnx o3756; B76-65.
e: g T ç-ák' oow T ç-ák' oow l Rí yx Zyyx s3 J SZ[ T A
Kooz Mbkác-o2l k-øn Zzoonr Lwyáyx Yony qx sáyx
] -sx q ár o Oso-k-nr snkv J yx éSZ[ T
Uoái y-u3T kár ow kásm 37575B> 67. A626@
e; g Yk-+sn T kw ç x ç-1 Zçksw kx Uy-súkw l W3 W3 HI nçv
T ktoon Hxí k-1 T ç-k Ykl sç T çkúç1 HI 3 Uk-s-
Hr wkn Mcur -s1 I k-s I s k Zkwkl Rr káçx Zkl s-k3
J ç-oxá Zákác-+J r kwox qo-l-kxn Wý-sl vo Zyç á y x -
yp LLN2l k-øn I -ksx] ywz ç á o- B á o- p k n o A H
J ywz-or ox-séo Yoésoi 3Myx á o- sx
Uoç-y-y1 yásm 37575B69
e<g Kk-+ Kol knk k1M6-k-s Wkçvl a kx q Qx3Konynsx q
Bwkqxon kxn Zzyuox W-k-ø-Myw Uyx 2x ék-séo
Uoç-kv -T LN. Zsqxkv-3Myx á o- sx
Uoç-y-nsx no37575B69
e>g Hxçwkn nr skws Nyzkk R3l J r k-áso- Q-+1 J r kx q
Lní k-n MB Zzoonr -ñx ár o-s-pyw x oç-kv nonynsx q
yp-zyuox -ex áox no-3Ukáç-o3756@B; ; >- <<: 8.
e@ Sçnu Záoéox Q Hk B á-y-nçnásyx áy ár o Léox á2
Yokáon Wýáox ákv [ onr x s' ç o l Zonyxn Lnsáyx3 o
T H[ Wo-AJ kw l -snqo1T HI] ZHB7569
e65g I k-+k-+kás Hs1 Mkáç-omr s T or-nkn1a k-n Ykl kl R1

I s-nr Nk-ñ L3 H ç-éon yp -sqxkv z-yno-sx q
kqy-sár w-sx l -ksx nywz ç á o- s á o- p k n o -l k-øn yx
ovoná-snkv l -ksx -sqxkv-3Qç-xkv yp Uoç-kv
Lxqxs oo-sx q3755<B9-7.
e66g ' kx-áox-øv T k-s-uk Ql Wóv-Lwk-N3l 3l I vosnr x o-
T k-ásx N3l I -kxny T k-skxk W3l Koxs-yx [ swyár ñl
Móçnox l ç-q dknr k-ñ ' 3l Ny-økk- Wóo-1 Sosx no-
Zknr klV ox- yw k-O3l ' kx Kox I ywv T ki H3l
' kx Ystox Wóo-J 3l Hk-x y ç á -e-L-su Ql Ykw-øn Usnu
MB Mçwñ Pwz vx áon I -ksx J ywz ç á o- B á o- p k n o s x k
Symon2Bx Wkásox á í sár HS Z3Uoí Lxqkxn Qç-xkv
yp T onsnx o3756; B8<: -76.
e67g Wkx nk-sxkár J r oár kx l Uçñçtç uskx Wkçvl I v k l o
J r -s-á s x o O1 Zy-sno I-s kxñ S1 Zkkl Qnl a swo
Mkxns-Y1 Oymrl o-q Sosqr Y1 Zr oxyñ R-s-+xk ' 1
Ooxno-yx Qsw so T3 Osqr z o-py-wkxno
nywwçx snkásyx l ñ zoyzvo í sár z k-kúñ-s-ç-sx q kx
s á-kny-ásvkl -ksx 2nywz ç á o- s á o- p k n o 3 o S ç w 3756<B;
e68g bso çç1 Vx sqk Záopkx 3 H Yoésoi yp Wýno-sx q
T oár yn-kxn J k-s-nkásyx Hqy-sár w py- LLN
Zsqxkv3J k-zkár skx Qç-xkv yp Lvoná-yxsm kxn
J ywz ç á o-Lxqxs oo-sx q37575B68-6.
e69g Zr k-yx Yxs s H3l Uk-kúnx kx Zr-sukx ár 1Zç-T -sqkx ukl
T ç-ár ñ Oowk H3l Hx Lwzs-snkv Záçññ yp Zzoonr
Wýno-sx q sár o I -ksx l ñ Hx kúñsx q ár o [ owz y-kv
Zñvkl vo Zá-çnác-o sx Zzoonr 2sx z ç á B nç n o n
LLN3H HZZW 756@ 2 756@ HLL B á o-x k á y x k v
J y x p o -o x n o y x H n y ç -á s m -+ Z z o o n r k x n Z s q x k v
Wýno-sx q -H HZZW 3756@
e6: g K wyx oá Qkx 2Mkx ys-+ so-ñ Nçswkçwo1
J k-nol ká Kywsxs' ço3 Yoxoi kv yp ár o
Uoç-yzr ñ-sy w qñ yp Skx qç kqoA Mçx n á y x k v
Uoç-y sw kq x q 3 W ñ -s y w q s n k v Y o é s o i -3755: B>: -6.
e6; g Osmnyu N-oqy-ñl Wýoz z ov Kkésn3 o ny-ásvkv
y-qkx súkásyx yp-zoonr z-y-no-sx q3Ukáç-o Yoésoi -
Uoç-y-nsx no3755<B>: .
e6<g T y náouç wk Sçs-Hyp ony1 [ y-o-2Nk-mk Hhotkx n-y
H3l ' svk-ø y-2Mkx onk Sçs-+J k-swy T kñk3 Zçl toná-
snoxás nkásyx ç-sx q LLN2-ony-non swkqxon
-zoonr 3Li z o-á Zñ-áow-+ sár H z z v n k á y x -3756@B66>
e6>g Zr k-yx Yxs s HI T ç-ár ñ Oowk H3l J ywz k-s-yx yp
Mbkác-o2T ynov ' k-skx á- py- ny Zzoonr 2LLN
J k-s-nkásyx 37575 Ukásyx kv J y x p o -o x n o y x
J y w w ç x s n k á y x -U J J . 375753
e6@ [ sl y T k-ár o3 Konynsx q LLN -o-zyx-ø-nç-sx q
z o-noz á y x k x n s w k q x s k á y x y p w ç -s 375753
e75g KkZkvk J r k-vo-Z3l Rkw l k-k Os-yñç us1 Zkáy T kuyáy 1
Rysuo c k-er k-ç3 Zsx qo2á-skv nk-s-nkásyx yp éyí ov
-zoonr swkqo-ñ ç-sx q nyw w y x -z k á k v
z k o-x-3Uoç-kv Uoái y-u-3755@B77-@
e76g Zy x q c y ç x q Q o l Z o z ç v é o n k M k x n s -m y 3 J k -s p n s x q
-zoonr -oúáon é-3snvo-ákáo áyí k-n-yx-éá noáonásyx
sx l -ksx 2nywz ç á o- s á o- p k n o -yé o-ál s x r s l s á o n y é o-ál
kxn nyé-á -zoonr -yçxn z-y-nçnásyx é-3 snvo
-ákáo37569 HLL I syw onsnkv J s-nç-sá-kxn Zñ-áow-
J y x p o -o x n o -I s y J H Z Wýno onsx q-375693
e77g drky Zr çxkx1 Yçnúsnú M k x u 3 J k -s p n s x q
z r y x y w q s n k v n k á o q y -s o -s x s w k q x s o n k x n k -á s n ç v k á o n
-zoonr 3756: HLL B á o-x k á y x k v J y x p o -o x n o y x
H n y ç -á s m -+ Z z o o n r k x n Z s q x k v Wýno-sx q

- H HZZW3756: 3
- e78g I yqco Yyl o-á3 I -ksx nywzçáo- sxáo-~~pkno~~-A nyxá-yv l ñ ár yçqr á3Bkñç-á-~~skv~~ Yyl yáA Hx Bkáo-xkásyxkv Qç-xkv375658B8<-7.
- e79g Wo-~~ov~~J y-o y No-w x H3I Nk-os-Rè x L3I Yç xo-O3Soyxk-ny3Vzox knno-~~nkákl~~ k-~~o~~ypLLN -~~sqx~~kv-~~ony~~-non nç-sxq swkqxon -~~zoonr~~ 367ár Bkáo-xkásyxkv Zñwzy-~~çw~~ yx T onsnkv Bkpy-wkásyx Wýno-~~sx~~q kxn Hkkuñ-s-3756<3
- e7: g Zí ooxoñ R3[ 3a k-n [ 3L3IT nšyyxo Z3MBH-áçkná Yowyékv sx Wñ-~~syw~~qsnkv Zsqxkv- Wknásno-~~kxn~~ Wý-~~á~~ sšáo-3LLL [ -kx-~~knásyx~~ -yx Bkpy-wkásyx [ onrxywqñsx I syw onsnx o37567B6; -8.
- e7; g LLN Zsqxkv Wýno-~~sx~~q kxn Mbkáç-o Li-á-knásyx3 Zz-sx qo-AZsxqkzy-oB756<@
- e7<g P-~~kw~~ T n Rk çvl Yk-áokk-x sk Hws-l c kxq drs3 T oár yn-~~py~~- k-áçkná noónásyx kxn -owyékv p-yw -~~nkz~~ LLNAH -oésoí 3Uoç-yzrñ-~~syw~~qso J vsx's' ço4 J vsxsnkvUoç-yzrñ-~~syw~~qñ3756; B9; -92 .
- e7>g V towkxx NH3 J y-ásnkv y-~~qkx~~súkásyx yp vksqçkqo3 o Qç-xkvypUoç-y-~~nox~~no36@B66->.
- e7@ Osmuyu N-oqy-ñil Wýozz ov Kkésn3 o ny-ásnkv y-~~qkx~~súkásyx yp -~~zoonr~~ z-yno-~~sx~~q3Ukác-o Yoésoí -Uoç-y-~~nox~~no3755<B>@8@29573
- e85g Osmuyu N-oqy-ñ3J ywzçákásyxkv x oç-ykxkáywñ yp -~~zoonr~~ z-yñçnásyx3Ukác-o Yoésoí -Uoç-y-~~nox~~no37567B68A68: 269: 3
- e86g Oo- J r-s-áskx l Ksoxo- Sy-oxúl Hxq-smu T sqç ovl T çqvo-Lwsñl [ káo T k r oí J 3INyvn-smu T k r oí H3I R-ç-~~sax~~-us Kokx Q Zçáúuñ T k-m a 3I Znr çváu [ kx tk3Nox o-kásx q Ukác-kvl Bk áowsqsl vo Zz oonr Myw I -ksx Hnásésñ sx T yáy-1 Wowyáy-1 kxn Bkpo-sy-Myx ákv J y-ásmo-3Myxáso-~~sx~~ Uoç-y-~~nox~~no3756@B68
- e87g Soçár k-ná L-sm J 3I Wós bskyZl osl I -o-~~ok~~- Qxkár kx1 Nkyxk J r k-~~to~~-1 Zr k-wk Tyr sál Moçnox l o-q d kml I k-l yç- Koxxs-1 Znr kvu No-í sx3 [ owzy-kv oéyçásyx yp qkw wk knásésñ sx r çw kx ny-áoi nç-sxq kx yéo-á kxn nyéo-á í y-n -oz oásásyx ák-u3Myxáso-~~sx~~ Oçw kx Uoç-y-~~nox~~no37567B;
- e88g Húk- Hr wkn [ kr-o-1 I kkv-~~'~~ kvox ásk l 3I V k-sç [ oyny-k3 J k-s-nkásyx yp LLN2 k-~~en~~ I -ksx J ywzçáo- Bkáo-~~pkno~~-3Hnékxnon Bk áowsqox á J ywzçákásyxkv [ onrxywqso-~~kxn~~ Kons-syx Zçzzy-á Zñ-áow -Zz-sx qo-1J r kw B7568A@265; 3
- e89g Bkñ3 I -ksx T k-á- [ onrxywqso-3 o sxáo-xkásyxkv 65 75 -ñ-áow3
- e8: g Rkñ Roxn-smu U1Nkwlxá Qnu S3Pnkx -eo í r ká ñyç -eo3Ukác-o Uoç-y-~~nox~~no3755@B67-8.
- e8; g Nos-xko-á Zswyx1 Mksnk-á [ yw1 I o-á-kxn Hvoí kxn o-3Hx Bkáo-z-oákl vo W6-py-wkx no T oá smpy-Hçnsáy-ñ H oxásyx Konynsxq Hwqy-sár w-~~sx~~ k J yxáoi á yp Uoç-yZáo-on Nksx J yxá-y3LLL [ -kx-~~knásyx~~ -yx Uoç-kvZñ-áow-~~kxn~~ Yor kl sšákásyx Lxqsoo-~~sx~~q37575B7>-6.
- e8<g Uk-~~ok~~-s- ywk-1 Rkñ Roxn-smu U3I Us-~~swy~~áy Zr sxtsl Nkwlxá Qnu S3Lxnynsxq kxn nonynsxq sx pI YP3Uoç-yBwqo37566B: ; -7.
- e8>g Rkxo-~~es~~-y I vks-1 Uqçñox Kçm [ 3I Uy-~~nsk~~ Hx ár yxñ T 3IKwymr yí -us Qnu W3I o-qo- Qxkár kx3Ukác-kv

- wç-sm oéyuo-ny-okáon LLN -o-zyx-o-o onásx q áowzy-kv -á-çnác-o kxn l oká3Uoç-yBwqo37575B 769
- e8@ Nos-xko-á Zswyx1' kx nonkzz owo Zo-ékk-1Hsmnyésn Lwsxkl no J r oéosqx Hksx1 Sky- Lnwçxn1 T oño- I o-xn [ 3I T s-kx Zsxkl Mksnk-á [ yw1 I o-á-kxn Hvoí kxn o-3 Uoç-yZáo-on Ook-sxq Koésno-A Konynsxq Hçnsáy-ñ H oxásyx Mýw ár o I -ksx375753
- e95g J kxás-~~lex~~s Nsy-~~qsk~~l L-sm Zsw1 Ysnr k-n Nkov3 LLN2 k-~~en~~ Konynsxq yp Hçnsáy-ñ H oxásyx áy k [ k-~~qoa~~ Bk-á-çw ox á sx Wývñz r yx sm T ç-~~sx~~3756@LLL a y-u-~~yz~~ yx Hz z vsnkásyx-yp Zsqxkv Wýno-~~sx~~q áy Hçnsy kxn Hnyç-~~ásm~~-a HZWHH 3756@
- e96g Ks Sál o-áy Nsyékkxs T 3I Wów J vks-o1 Zr kw wk Zr sr kl 1 no J r oéosqx Hksx3 T ç-~~snkv~~ oiz o-ás-~~o~~ ox r kxn-~~ár~~ o ny-ásnkv á-kmúsxq yp ár o knyç-ásm ox éowz o nç-sxq xkác-kvs-ásm wç-sm vs-áox sx q3Hnyç-ásnkv Znox no kxn [ onrxywqñ37575B 96-6.
- e97g [-ono- T Zl Wç-í sx-O1 T suynñ K1 Zác-w Pl I vksuo-áú I 3 Konynsxq kçnsáy-ñ k oxásyx áy sx-á-çw ox á-sx zyvñz r yx sm wç-~~sx~~ç-~~sx~~q -~~sx~~qo2á-skv LLN mk-s-nkásyx3Qç-xkv yp Uoç-kv Lxqsoo-~~sx~~q37569B66-7.
- e98g Wý-1 knx squ Hxxo1a o-á-~~T~~ k-ou1J kwso-Qx Wáo-1 Znr çváu [ kx tk3 LLN2 k-~~en~~ Zz oonr Yonyqx sásyx 2 Rw zkná yp [ owzy-kvL oná-3755@
- e99g KkZkwk J r k-~~wo~~-Z3I Rkw l k-k Os-yñçusl Rysuo c k-~~er~~ k-ç1 Zkáy T kuyáy3 Zz káskv váo-sxq kxn -~~sx~~qo2á-skv mk-s-nkásyx yp LLN nç-sxq éyí ov -~~zoonr~~ swkqo-ñ3Wýnoonsxq-yp ár o 8-n Bkáo-xkásyxkv J yx éoxásyx yx Yor kl sšákásyx Lxqsoo-~~sx~~q \* H-s-áso [ onrxywqñ 2 H YLH L 5@3755@
- e9: g Nk-mkZkvsxk-Q-Z3I ' swk-~~o~~ y-2Wxonk Sçs-1 Yoño-2Nk-mk J k-w-Hl o-áy1 [ y-o-2Nk-mk Hhotkxn-y3 [ ox-y- Konywzy-sásyx py- Bwkqxon Zz oonr Ks-~~msw~~sxkásyx sx LLN3BAl káñ-~~es~~x Rnk-1 T k-á-x ou2 swk-~~o~~ y- T k-k no Syç-no-1 L-z-sx y-k Os-kw L-on x Wýxno3Hnékxno-~~sx~~ J ywzçákásyxkv Bk áowsqoxno3 T H HP 756>3 Sonác-o Uyáo-~~sx~~ J ywzçáo-Znox no3Zz-sx qo-1J r kw B756@78@79@
- e9; g K,dwç-k T smr kovl Koxq Zšñsl Skz zk-[ yw1 y-z o Zkwç ovl Z-sx sék-~~lex~~ Ykwo-~~es~~3[ yí k-n LLN Zox-sxq yp Bwkqxon Zz oonr 3Oçw kx 2 ywzçáo- Bkáo-knásyx3 Uoi [-oxn-3755@
- e9<g T y-~~o~~-Kkésn H3Soyxk-n T k r oí R3IT kusx Q-~~ez~~ r N3I J r kxq Lní k-n MB Yok2aswo nonynsxq yp ' ço-ásyx 2kxn2x-í-o-~~zoonr~~ nskwqç o ç-~~sx~~q r çw kx ny-ásnkv knásésñ3Ukác-o J ywvçx snkásyx-3756@B65 -6.
- e9>g Koxq Zšñsl Z-sx sék-~~lex~~ Ykwo-~~es~~1 Skz zk-[ yw1 K dwç-k T smr kov3 LLN mk-s-nkásyx yp swkqxon -~~ñwkl~~ vo -r ñár w ç-~~sx~~q Osl o-á -~~zoonr~~ çw wo ár yn-3Qç-xkvypUoç-kvLxqsoo-~~sx~~q37565B<-9.
- e9@ Xç-o-~~es~~ T çr kw wk Ukéoon P l kv l T sx I oywtçx l W-~~u~~ Oñoqxq2Qx1J ry Kyxq-ko1J rys a yy-~~es~~1Soo I y-oyw3 T çvámk- J k-s-nkásyx yp a y-n Bwkqsx kásyx Zz oonr a sár Oñl -sn J yxx onásésñ Mbkáç-o-3LLL [ -kx-~~knásyx~~ -yx I syw onsnkv

Lxqsoo-sxq3756>B; :-65.

- e: 5g I -sq r kw Rkár k-sx o1Rçwk-I 3' 3R3' stknk3Zçl toná snox ás nkásyx p-yw ovoná-yoxnoz r kwq-kw -LLN. -seqkv-nç-sxq swkqso on -zoonr 3 7565 Mç-ár HLLL Bkáo-xkásyxkv J yxpw-oxnó yx I sywoá-smA oy-níl Hzz vsnkásyx-kxn Zñ-áow-I [ HZ 375653
- e: 6g I -sq r kw Rkár k-sx o1Rçwk-I 3' 3R3' stknk3Pwkqso on Zzoonr J vk-s nkásyx í sár LLN Zsqxkv-py- Zsox á J yw çx snkásyx AH Wosw sx k-n Bkéo-ásqkásyx sx áy Zñx ár oásm [ ovoz kár ñ3 7565 9ár Bkáo-xkásyxkv J yxpw-oxnó yx I syxpy-wkasm-kxn I sywonsnk v Lxqsoo-sxq375653
- e: 7g Hçkvor T k-ekovl T yy-o Yyqo-I J r-s áox-ox Oosnl H-ékk or T kr xkú3Ks-masw sx kásx q I oái oox Pwkqso on Zzoonr kxn UyxZZoonr [ k-u- ] -sxq LLN3 756> 95ár Hhxçkv Bkáo-xkásyxkv J yxpw-oxnó yp ár o HLLL Lxqsoo-sxq sx T onsnx o kxn I sywqn Zynoañ -LT I J . 3756>3
- e: 8g J r sb çow sx 1Okqony-x Qr x I 3Znr yyxyéo-Kkxsovl K dwç-k T snr kov3 LLN2 k-en Ks-masw sx kásyx yp Pwkqso on Zzoonr W yxow o-3 Bkáo-xkásyxkv Qç-xkv ypl syoná-ywkqoás-w 37566B68-9. A56275; 3
- e: 9g a kxq Ssl dr kxq bsyxql dr yxq bçopsl dr kxq c ç3 Hxkvñ-s-kxn mk-s nkásyx yp -zoonr swkqo-ñ LLN py- I J B I sywonsnk v Zsqxkv Wýno-sxq kxn J yxá-yv37568B>; .
- e: : g Nçy T 3I 3 Xs d 3N3 a kxq S3 b ç N3 Yo-ek-nr yx zk-kw oáo- yz ásw súkásyx sx -zoonr -or kl seakásyx -ñ-áow l k-en yx I -ksx J ywz çáo- Bkáo-çkno3 Qç-xkv yp Zsqxkv Wýno-sxq3756>B89- . A@: 2@83
- e: ; g T ká-çwyáy T k-suy3 Zsox á -zoonr nonyno- ç-sxq knkz áseo nywonásyx3 Wýnonoxq-yp ár o nywz kx syx zçl vsnkásyx yp ár o 6(ár sxáo-xkásyxkv nyxpw-oxnó yx Bkáo-sqox á ] -ø- Bkáo-çkno- 2 P] P J ywz kx syx 69375693
- e: <g I kur -kvs T yr kwkn Hwsx l Rr knows T y-áoukl Ll -kr sws2T yqr knkw Hl l k-4T yqr sws Zkr k-3 LLN -seqkv mk-s nkásyx yp swkqso on -zoonr l k-en yx Ysow kxxskx ns-áknó yp ny-ox á-yzñ -z-oná-kv nox-sáñ3 I sywonsnk v Zsqxkv Wýno-sxq kxn J yxá-yv37575B: @
- e: >g H-kpká Z Rkús c k-ø-1 Rkxkno Zçnr s- Z3 Pwkqso on Zzoonr LLN Zsqxkv Wýno-sxq Mç-I -ksx J ywz çáo- Bkáo-çkno3 Bkáo-xkásyxkv Qç-xkv yp Hzz vsnkásyx y- Bxyékásyx sx Lxqsoo-sxq \* T kxkqow ox á37569B8 -<. A678267; 3
- e: @ T yr kxnr kxn-k Rç-çwk l Zkr k Zx or kx -ç3 H J yw çx snkásyx Wk-knsqw ] -sxq Zçl éynksúon Zzoonr A [ -kx-kásx q I -ksx Zsqxkv- sx áy Zzoonr 3 Hçqw ox áon Oçw kx Yo-ek-nr 3756; B6- 6.
- e: 5g Rkw kkuukxxkx Y3l Yktuçwk- Y3l Ykt T 3 T knkx l Zr ox l kqk ZK 3 Pwkqso on -zoonr mk-s nkásyx ç-sxq LLN3 Hnékxno- sx I sywonsnk v Zsoxno kxn Lxqsoo-sxq37569B6-7. A52873
- e: 6g P l kv Zknkpl ] útkw kx Rr kx c ç-çpl Mk-yy' Vwk-3 LLN l k-en mk-s nkásyx ypswkqso on éyí ov-yçxn-3 756: 3
- e: 7g Rh-oo-I k-sw T 3l Mk-yy' Vwk-3 LLN l k-en éyí ov mk-s nkásyx nç-sxq -zoonr swkqo-ñ3756; 3
- e: 8g Rh-oo-I k-sw T 3l Mk-yy' Vwk-3' yí ov mk-s nkásyx

- ç-sxq í kéowá nonywzy-sásyx nç-sxq -zoonr swkqo-ñ3 756; 8-n Bkáo-xkásyxkv J yxpw-oxnó yx Zsqxkv Wýno-sxq kxn Bkáoq-káon Uoái y-u- -ZMU. 3756; 3
- e: 9g T sx I oywtçx l Rsw Qxqxl Wk-u Oño yx q2çx l Soo I y-oyw3 ' yí ov Pwkqo-ñ Konynsxq áyí k-n Zsox á Zzoonr I J P ] -sxq Li á-ow o Sok-x sx q T knr sx o í sár Lvoná-yoxnoz r kwq-kw 3 I sy T on Yo-ek-nr Bkáo-xkásyxkv3756; B756;
- e: ; g Yytk-Ksoqy H3l Ykwy-Vvqk S3l Q-çqo L3 Zkl ñ3 Yonyqxsásyx yp Zz kxs-+ ' yí ov-ár -yçqr Pwkqso on Zzoonr l ñ ç-sxq Zz oná-kv Hxkvñ-s-kxn Z' T 3 Qç-xkv yp Bpy-wkásyx Osnxq kxn T çáswonsk Zsqxkv Wýno-sxq3756; B<- 9. A>@>@&3
- e: ; g [ kx Wxq l Zk a osz sx ql c ç Ssx qw3 Hz z vñsx q Li á-ow o Sok-x sx q T knr sx o áy mk-s nkásyx yp LLN I J B3756; HLLL Bkáo-xkásyxkv J yxpw-oxnó yx J ñl o- [ onr xywqn sx Hç áywkásyx l J yx á-yvl kxn Bkáo-sqox á Zñ-áow -J c l LY. 3756; 3
- e: <g [ kw w T k-uç-2V véo-3 ' yí ov J vk-s nkásyx p-yw Pwkqso on Zzoonr ] -sxq T knr sx o Sok-x sx q375753
- e: >g Wkáo v Qqk-l Wk-ek P3Hl R-s-+xk K3 Ok-ç3 J vk-s nkásyx yp swkqo-ñ éyí ov -zoonr ç-sxq LLN kxn may -ny-ovkásyx3 Bkáo-xkásyxkv Qç-xkv yp Wç-o kxn Hzz w on T kár ow kásm-3756>B66>- 79. A62653
- e: @ Yotúknor Zo-o-+uor Hd y-ú l [ -y Yyl o-á l I -snyç á Hç-ovsox l J r kç [ yw3 LLN J vk-s nkásyx yp J yéo-á Zzoonr ] -sxq Yoqçvk-súon Uoç-kv Uoái y-u-3 HLLL4 HJ T [ -kx-kásyx -yx Hç nsy l Zzoonr l kxn Skx qç kqo Wýno-sxq3756<B7: - 67.
- e<5g I kktks Hnéksál Oknk- Hzk-ktakl Wkáv Ro-+ké l Yçár ésu [ Zks l J H ' kwskz kx l Q-ák-uk- T knç-1 I kár -' oouñ3 LLN2 k-en mk-s nkásyx yp l sx qç kv çx-zyuox -zoonr ç-sxq HUU3 756< 8(ár Hhxçkv Bkáo-xkásyxkv J yxpw-oxnó yp ár o HLLL Lxqsoo-sxq sx T onsnx o kxn I sywqn Zynoañ -LT I J . 3756<3
- e<6g Zr k-yx Yxs H3l Uk-kñkxkx Zr-sukx ár Z3l Zç- T -sqkx uk l T ç-ár ñ H3 Oowk3 Uoç-kv Zzoonr Konynsxq Kç-sxq Hç nsásyx l Pwkqso kásyx kxn Wýnç násyx3 HLLL Hmo-37575B>
- e<7g Zkr k Wkw sál Mv-Zsnx oñ3 Oso-k-nr snkv Kooz Mbkác-o Sok-x sx q py- Konynsx q Pwkqso on Zzoonr p-yw LLN3 756@
- e<8g Wkxknr kuov Q-sx ywk-4 Ykwku-s-+kx H3N3 Hxkx ár kz knw kx kl r k [ 3 H Uyéov Kooz Sok-x sx q H-nr sáonáç-o py- Konynsx q Pwkqso on Zzoonr p-yw LLN3756@
- e<9g J yyx oñ J sk-kx l Ry-su H sk l Myws Yk kowk l J yño Kkw sox O 3 J vk-s nkásyx yp Pwkqso on Zz yuox a y-n 2Wks- ] -sxq J yx éyç ásyx kv Uoç-kv Uoái y-u-3756@
- e<: g Yyñ c kxx sm l l kx éswo Oç l o-á l Hd ç' ç o-' ç o P-Hd ok l N-kw py-á Hvoí kxn-o l Mku [ skqy O l Mç l o-á Qnoñx 3 Kooz vok-x sx q l k-en ovoná-yoxnoz r kwq-kz r ñ kxkvñ-s A k -ñ-áow kásm -oésoí 3 Qç-xkv yp Uoç-kv Lxqsoo-sxq3756@B6; :- .
- e<: g [ kw w T k-uç-2V véo-1 T ç r kw wkn c k-1 T ç r kw wkn Ukéoon3 J vk-s nkásyx yp ' yí ov-p-yw Pwkqso on Zzoonr í sár J yx éyç ásyx kv Uoç-kv Uoái y-u-3 J ywz çáo-37575B@7.

e<<g J yx oñ J sk-kx1 Mjws Yk kowk1 J yñvo Kkwsox3  
 Vz ásw súsxq Skño—Pwz-yéo—J UU Noxo-ksúkásyx  
 kxn [-kx-pø- Sok-xsxq py- Pwkqson Zzoorn  
 Komy nsq pyw LLN3756@ HLL Bxáoxkásyxkv  
 J yxp-oxnø yx Zñ-áow-t T kx kxn J ñl o-xoásm—  
 -ZTJ. 3756@



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