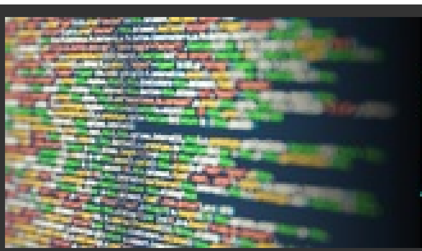
Personal space regulation in childhood autism spectrum disorders.

Download Here

ADVERTISEMENT



Machine Learning:
A Multi-Journal Call for Papers
Lea

OPEN ACCESS PEER-REVIEWED

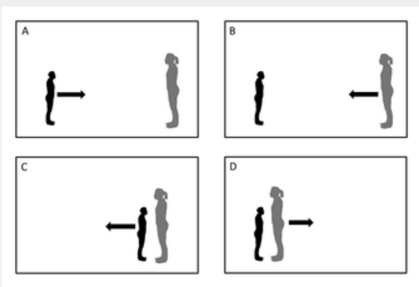
RESEARCH ARTICLE

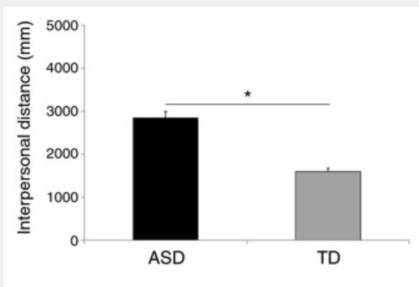
Personal Space Regulation in Childhood Autism Spe Disorders

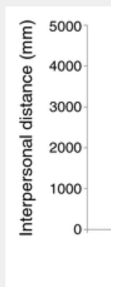
Erica Gessaroli, Erica Santelli, Giuseppe di Pellegrino, Francesca Frassinetti

Published: September 23, 2013 • https://doi.org/10.1371/journal.pone.0074959

Figures







Abstract

People appropriately adjust the distance between themselves and
interaction, and they may feel discomfort and move away when anc
on their personal space. In the present study, we investigated pers
with persistent difficulties in the domain of social behavior, such as
spectrum disorders (ASD), and in children with typical development
distance paradigm was used to derive estimates of interpersonal d
after a brief interaction with an unfamiliar adult confederate. The re
children felt comfortable at a greater distance compared to TD chilc
personal space shrunk after interaction with the confederate in TD
do so in ASD children. These findings reveal that autism deeply affe
personal space, influencing both its size and flexibility.

Citation: Gessaroli E, Santelli E, di Pellegrino G, Frassinetti F (201
Regulation in Childhood Autism Spectrum Disorders. PLoS ONE 8
https://doi.org/10.1371/journal.pone.0074959

Editor: Michel Botbol, University of Western Brittany, France

Received: March 18, 2013; **Accepted:** August 8, 2013; **Published:**
2013

Copyright: © 2013 Gessaroli et al. This is an open-access article
the terms of the Creative Commons Attribution License, which pe
use, distribution, and reproduction in any medium, provided the
source are credited.

Funding: This work was supported by grants from the University
(Ricerca Fondamentale Orientata) to FF and GdP, and from the M
Università e Ricerca (PRIN 2010, protocol number: 2010XPMFW4
funders had no role in study design, data collection and analysi
publish, or preparation of the manuscript.

Competing interests: Note that co-author GdP is a PLOS ONE Edi
member. This does not alter the authors' adherence to all the Pl
sharing data and materials.

Introduction

Personal space is the area individuals maintain around themselves
intrusion by others may cause discomfort or even anxiety. People c
appropriately regulate their interpersonal space to obtain a comfor
interaction with others [1-4]. When personal space is violated, the p
to reinstate the margin of safety. Thus, personal space is fundamer
space, a zone of safety surrounding the body [5].

A number of studies have shown that the size of the personal spac
social context. A person who is placed in a potentially threatening c
expanded personal pace; a person in friendly company will have a
space [4,6]. Moreover, the size of interpersonal space can change
different factors, including gender [7], age [8], infant–caregiver atta
familiarity between interacting parties [11,12]. Studies have also do
psychiatric [13], neurological [14], and developmental disorders [15
regulation of personal space.

More recently, Kennedy and coworkers [14] described the regulati
distance in a patient (SM) with bilateral amygdala damage. In their e
authors asked SM to indicate the position at which she felt most co
experimenter approached her, or she approached the experimente
substantially reduced personal space compared to comparison su
in which the patient rated her level of comfort/discomfort standing
from the experimenter, put in evidence that SM was perfectly comf
to-nose distance with the experimenter. These findings revealed th
the amygdala results in no detectable personal space boundary a
interpersonal distance preference, thereby suggesting that this br
the neural substrate regulating the distance between individuals. M
neuroimaging data from healthy subjects in this same study [14] sh
activation of the amygdala when participants knew that an experim
a close distance to them, compared to when they knew that an exp
maintaining a far distance. This conclusion is supported by the resu
primate studies, revealing that monkeys with bilateral amygdalar d
stay in closer proximity to other monkeys or people compared to m
[16-18].

Because personal space represents the space of interaction and c
others, it is critical to study this space in subjects with everyday diff
emotional behavior, such as patients with autism spectrum disorde
neurodevelopmental disorder characterized by marked and endur
interpersonal interaction, including behavioral avoidance and unre
and failure to spontaneously interact with people [24,25]. Moreover
that dysfunction of the amygdala may be responsible, at least in pa
of social and emotional functioning that is a core feature of autism
relatively little is known about the way in which autistic individuals
distance from other people during social interactions. Although ane
and some meager evidence [30] suggest that the ability to reliably
from other people may be impaired in ASD, interpersonal distance
measured in individuals with autism in a laboratory test.

In the present study, our primary aim was to provide a direct measu
space of children with typical development (TD) and children with a
approach, such as autism (ASD). The second aim was to investigate
personal space by a brief social interaction with an unfamiliar othe
populations of children. To this end, we measured personal space
version of the stop-distance procedure [31-33]. This paradigm repre
frequently used measure of personal space regulation, allowing re

preferred interpersonal distance under varied conditions and repe
reviews, see [8,33]). In our experiment, personal space was measu
which children felt most comfortable as an unfamiliar adult confede
or they approached the confederate. Each participant was tested tv
after a break during which participant interacted with the confedera

Prior research has suggested that an excessively functioning amyg
abnormal fears and enhanced anxiety in autistic children, leading t
interactions and avoidant behaviors in these patients [34-39]. Acco
hypothesized that ASD children, due to increased fear and hyperar
personal space violations, would fail to reliably and flexibly regulate
thereby maintaining a farther and rigid distance from others. As a c
predicted that interpersonal distance would be larger in ASDs than
should be modulated by a brief social interaction in TD but not in AS

Methods

Ethics statement

The study involved children with autism spectrum disorders and ch
development in a behavioral experiment. Subjects' parents gave w
to their children's participation in the study, which was approved by
of the Centro Autismo, Ausl, Reggio Emilia, where the experiment wa
the ethics committee of the Department of Psychology of the Univer
experiment was conducted according to the ethical guidelines of th
Helsinki.

Participants

Fifteen male children with autism spectrum disorders (ASD) particip
autistic children were recruited through referrals from a center for
(Reggio Emilia, Italy). They will hereby be designated as the group o
All had received a formal diagnosis of an ASD by an independent cl
the standard Diagnostic and Statistical Manual of Mental Disorders
were high functioning. The diagnosis was confirmed using the Autis
Observation Schedule-Generic (ADOS-G) scale [41], given by a train
psychologist. ASD children had all fluent language abilities. They ha
neurological (e.g. cerebral palsy or epilepsy) or medical disorders,
taking antipsychotic drugs at the time of testing.

We compared the ASD children to 23 male children with typical deve
TD children). TD children were recruited in local schools and were f
psychiatric or neurological illness as determined by history.

ASD and TD groups did not differ with respect to both mental (TD = 9
years; ASD= 9.07 years, sd =2.43 years; [F(1,36) = 0.05; p = .85]), and
= 9.56 years, sd = 1.73 years; ASD = 9.73 years, sd =2.37 years; [F(1,3

Table 1). The mental age was calculated by using the formula (chro IQ/100). The Total IQ scores were measured with the WISC-III, submi session different from the experimental session.

	ASD Group (N=15) (Mean/SD)	TD Gro (Mean
Chronological Age	9.73 (+/- 2.37)	9.56 (+/-
Mental Age	9.07 (+/- 2.43)	9.17 (+/-
Full Scale IQ	92.73 (+/- 16.08)	97.61 (+/-
ADOS (Full Scale)	15.6 (+/- 3.37)	NA
ADOS (Social interaction)	8 (+/- 2.24)	NA
ADOS (Communication)	5.8 (+/- 3.12)	NA
ADOS (Imagination)	1.2 (+/- 0.77)	NA
ADOS (Behaviors)	1.67 (+/- 1.72)	NA
Diagnosis	9 (F84.9) 6 (F84.0)	NA

Table 1. Subject Demographics for Children Participating in the Stu

IQ assessed with Wechsler Intelligence Scale for Children–Third Edition (WISC- Abbreviated Scale of Intelligence (WASI)

Download CSV

Procedure

We applied an adapted version of the stop-distance paradigm used [14]. All participants were tested in the same room (7 x 4 m) by one e confederate. The role of the experimenter and confederate was tak taken to ensure that the experimental setup remained identical acr

Testing began with a participant positioned at a fixed location in the confederate standing, facing the participant from a far starting posi from a close starting position (30 cm). In half of the trials, the female always the one moving, at a natural gait either toward (i.e., far starti (i.e., close starting position) from the participant. In the other half of participant was always the one moving, either approaching or witho confederate (see Figure 1). Participants were instructed to tell the c their preferred distance (i.e., the distance between themselves and which they felt most comfortable), in the trials when the confederate chose their ideal interpersonal distance in the trials when they were approach/withdrawal movement, the confederate made no eye co neutral facial expression, and never touched the participant. The in was measured with a digital laser measurer (Agatec, model DM100 distance between the confederate' toes and the participant's toes.

Download:

PPT Pow

PNG larg

TIFF orig

Figure 1. Experimental procedure.

In the first condition (A) the participant approached the confede
far distance (5 m). In the second condition (B) the confederate a
participant starting from a far distance (5 m). In the third conditio
moved away from the confederate starting from a close distanc
the fourth condition (D) the confederate moved away from the p
from a close distance (face to face).

https://doi.org/10.1371/journal.pone.0074959.g001

The same procedure was repeated twice, before and after a 10-mi
During the time interval, the confederate invited the subject to seat
placed in the same room and to read together an illustrated book c
participant. The children could choose one illustrated book among
which had been suggested by their teachers or psychologists as b
interesting for each child. During the interaction, the confederate re
asked three questions concerning the content of the book, while ea
invited to make comments and ask questions to the confederate. In
amount of this social interaction, the experimenter assigned a scor
each of three behaviors: i) the child's ability to answer to the confe
the child's ability to make comments about the book, and iii) the chil
questions to the confederate. These three ratings were averaged t
index of social interaction.

Before starting the experiment all participants received an explana
had four practice trials with the experimenter. Then the confederat

To sum up, we run a 2x2x2 design with starting position (close and f
(confederate and participant) and session (before and after social i
Each cell of the experimental design comprised 3 trials, thus yieldin
completely randomized trials.

Results

The effect of social interaction on personal space regulation was v
TD and in children with ASD by comparing the interpersonal distanc
before and after the interaction with the adult confederate. To this a
analysis of variance (ANOVA) was conducted on the measure of int
expressed in mm, with group (ASD and TD) as a between-subject va
(before and after social interaction) as a within-subject variable. Fo
analysis, data were collapsed across person moving (confederate
starting position (close and far) condition.

The variable group was significant [F(1,36) = 14.84; $p < .0001$; $\blacksquare_p^2$=
the interpersonal distance was larger in ASD children than in TD chi
1595 mm, respectively; see Figure 2). There was also a marginally s
session [F(1,36) = 3.80; $p = .06$; $\blacksquare_p^2 = .096$], showing that interperso
larger before (2175 mm) than after (2022 mm) the social interaction.

Download:

PPT Pow

PNG larg

TIFF orig

**Figure 2. Mean preferred distance from the confederate in child
spectrum disorders (ASD), and children with typical developme**

Asterisk indicates significant comparison ($p < 0.05$). Error bars d

https://doi.org/10.1371/journal.pone.0074959.g002

Critically, the main effects were qualified by a significant group X se
[F(1,36) = 7.73; $p < .01$; $\blacksquare_p^2 = .177$]. Indeed, post-hoc analysis showe
interaction between participant and confederate during the interva
personal space in ASD children (before = 2826 mm, after = 2874 mm
modulated personal space in TD children, reducing the distance aft
compared to before (1730 mm), the social interaction ($p < .003$; see
interpersonal distance was larger in ASD children than TD children
social interaction ($p < .0002$ for both comparisons).

Download:

PPT Pow

PNG larg

TIFF orig

**Figure 3. Mean preferred distance from the confederate before a
social interaction in children with typical development (TD), and
Autism Spectrum Disorder (ASD).**

Asterisk indicates significant comparison ($p < 0.05$). Error bars d

https://doi.org/10.1371/journal.pone.0074959.g003

For completeness, we also run an additional ANOVA that included a
specifically group (ASD and TD) as a between-subject variable, and
(confederate and participant), starting position (close and far), and

after social-interaction) as within-subject variables. As before, this s demonstrated that the variable group [F(1,36) = 14.84; $p < .0001$; $\blacksquare$ [F(1,36) = 3.80; $p = .06$; $\blacksquare_p^2 = .096$], and the group X session interact .01; $\blacksquare_p^2 = .177$] were significant. We also found that the interaction person moving, and starting-position was significant [F(1,36) = 8.24; Post-hoc analysis of this three-way interaction showed that, in ASD interpersonal distance was significantly larger when the participan (3376 mm) rather than toward (2413 mm) the confederate ($p < .0001$ difference was not significant when the confederate moved away o participant (when starting close = 2630 mm; when starting far = 297

In TD children, this difference was not significant neither when the away or approached the confederate (when starting close = 1781 1417 mm), nor when the confederate moved away or approached t starting position = 1.493 mm; far starting position = 1.688 mm; all p that the interpersonal distance remained larger in ASD children tha regardless of person moving (confederate or participant), or startin ($p < .001$ in all comparison).

The lack of modulation of interpersonal distance may depend on po interaction with the confederate in ASD compared to TD children, ar personal space regulation. To explore this possibility, an index of so ranging form 0 to 3, was computed for each participant by averagin assigned by the experimenter to three behaviors observed during interaction (see Method). Although the social interaction index of th somewhat lower than control group (2 and 2.3, in ASD and TD childre analysis did not reveal a significant main effect of group, [F(1,36) = Nevertheless, to ensure that our findings were not driven by subtle the amount of social interaction with confederate, the main ANOVA social interaction index as covariate. The previously significant gro interaction remained significant, [F(1,35) = 6.8; $p < .01$; $\blacksquare_p^2 = .16$]. As analysis, we ranked ASD participants based on the index of social i participants into good-interaction (ASDgi, n = 7) and poor-interactio thorough a median split. Finally, an ANOVA was performed on the m space difference (interpersonal distance after interaction – before (ASDpi, ASDgi) as between-subject variable. The variable group was = 1.01; $p = 0.33$]. Overall, these data suggest that the lack of modula distance were not due to reduced social interaction with the confed interval in ASD compared to TD children.

Control experiment

Our data suggest that social interaction influences personal space children. However, to ensure that this effect in TD children was not interval between the first and the second measure, or to a familiari with the confederate, rather than to the effect of social interaction b confederate and the subject, an additional control group of 23 age- (TD-C) was tested.

The TD-C group was submitted to the same procedure previously d
difference that during the time interval participant and confederate
together, but the subject read a book by himself, while the confede
something else in the same room. If the reduction of the personal d
children was due to time interval *per se*, then it should be found both
TD-C group. By contrast, if the reduction of the interpersonal distanc
interaction between confederate and subject during the time interv
found only in TD but not in TD-C group. TD-C children and TD were c
with group (with and without social interaction) as a between-subje
session (before and after time-interval), as a within-subject variable

The variable session was significant [F(1,44) = 11.49; $p < .001$; $\blacksquare_p^2$
interpersonal distance was smaller after (1592 mm) than before (17
interval. In line with the hypothesis, the group X session interaction
= 9.48; $p < .001$; $\blacksquare_p^2 = .18$]. Post-hoc comparisons (Tukey for equal
of personal space in the group with social interaction (TD group, be
=1460 mm, $p < .0002$), but not in the group without social interaction
1735 mm, after = 1722 mm, $p = .97$). Moreover, the personal space w
different between the two groups after ($p < .0001$) but not before (p
(Figure 4).

Download:

PPT Pow

PNG larg

TIFF orig

**Figure 4. Mean preferred distance from the confederate in two g
with typical development before and after a time interval during
confederate interacted (TD group), or not (TD-C group), with th**
Asterisk indicates significant comparison ($p < 0.05$). Error bars d

https://doi.org/10.1371/journal.pone.0074959.g004

Discussion

In this study, we investigated personal space regulation in children
development (TD) and in children with high-functioning autism, befo
interaction with an unfamiliar adult confederate. While previous an
have suggested that ASD children have some difficulties in approp
distance from other people during social interactions, the empirical
this claim has been conspicuously lacking. Here, a stop-distance pr
derive measures reflecting tolerance of, and reactiveness to, spati
TD children. We provide new evidence that personal space regulat
functioning ASD children. Specifically, we found that ASD children a

close proximity to an unfamiliar adult and prefer farther interpersor
to TD children. Moreover, results showed that interpersonal distanc
children when they *move away* from, rather than toward, the confed
these children feel more uncomfortable and react (i.e., step away) r
personal space violations (i.e. close starting position) than TD childr

A critical finding of the present study concerns the modulation of a
on personal space regulation. Previous studies focused on the effe
of long-lasting interaction, such as infant-caregiver attachment [9,1
between interacting partners [11,12]. Here, we report that a transito
with an unknown adult results in a rapid, on-line adjustment of the i
in TD children, indicating that personal space regulation exhibits dy
higher flexibility that may facilitate social interactions and communi
individuals. Such interpersonal distance changes were not simply d
time interval between the first and the second interpersonal distan
participants' familiarization with the stop-distance procedure or the
demonstrated by the results of a control experiment. Indeed, when
between first and second stop-distance procedure normally develo
book alone without interacting with the confederate, no change in t
space was observed. Critically, ASD individuals failed to display cha
distance in response to a brief social interaction, suggesting a mark
personal space in this condition.

In the past few years, a distinction has arisen between flexibility an
personal space. Permeability refers to the ease with which persona
or intruded upon, irrespective of its current size or shape, while flex
situationally induced changes in the size and shape of personal sp
suggest that, in autistic children, personal space is altered both in p
larger in ASD then in TD children, and in flexibility, since it is not redu
interaction with the confederate. We propose that the impairment ir
permeability of personal space in ASD children reflects overarousa
induced by others intruding their social space.

A previous lesion and neuroimaging study in humans suggested th
a key role in underpinning personal space regulation [14], either by
emotional reactions in response to personal space violations, or le
between close distance and aversive outcomes. Linking these prev
present findings, we suggest that reduced tolerance of physical clo
stranger and lack of flexibility of personal space in ASD children ma
impairment of an amygdala-based mechanism. This hypothesis is s
data. Recent studies indicate that the amygdala is enlarged in child
and could contribute to the abnormalities of fear and anxiety that a
feature of autism. An excessively functioning amygdala may accou
autonomic responses in autistic children (e.g., [34,37], but see also
results) leading to withdrawal from social interactions [37]. Moreove
older children and adults with autism provide evidence of an abnor
amygdala activation in response to social stimuli [39,48-50]. This is
findings in an animal model of autism, in which rats exposed to valp
autism-like symptoms associated with enhanced anxiety and fear p

amygdale [38]. Finally, recent evidence indicates that oxytocin, a ne
reduce activity in the amygdala, thereby resulting in decreased fea
modulate social distance in interacting partners [52], and improve s
ASD individuals [53].

Several prior observations are in keeping with the present findings
naturalistic observation method, Rogers and Fine [54] compared th
behaviors of an autistic and asymbiotic psychotic child during play
child maintained a greater personal distance from the therapist co
symbiotic child. Moreover, Parson and colleagues [55] compared th
and use some virtual environments, such as a Virtual Cafè, in a soc
ASD participants of 13-18 years of age and in age-matched control
results showed that the majority of autistic subjects seemed to hav
understanding of the virtual environment as a representation of re
participant's ability relative to some social norms was judged by na
were more likely to be judged as bumping into, or walking between
virtual scene, compared to their paired matches. The authors sugg
understanding personal space is impaired in autism. More recently
colleagues [30], analyzing parent- and teacher-report questionnai
that ASDs children are less aware of social distance than their una
showing significantly higher levels of interpersonal distance violati
Overall, these previous findings are consistent with the present res
general conclusion that interpersonal distance regulation is impair
results of increased violations of personal space in autistic individu
Parsons et al. [55] and Kennedy et al. [30] studies are not in accord
patterns observed in the present study, in which ASD children exhi
distance preference. However, several methodological differences
studies and the present one may account for the seemingly discre
instance, Parson and colleagues [55] study differed from ours in th
figures and scenes to probe personal space. It is possible that part
group bumped into the people in the virtual environment because t
understanding the virtual environment as representations of reality
and colleagues [30] analyzed questionnaire-based data and did no
controlled assessment of personal space in ASD children. Thus, int
measures and paradigms remain to be systematically compared in

Two potential limitations of this study deserve mention. First, our su
increased fear and hyperarousal following personal space violatio
larger interpersonal boundaries in ASD compared to TD children re
Physiological reactions, such as skin conductance responses and
subjective ratings of experience may provide potential measures o
present behavioural data support the claim that personal space re
autism, they cannot directly ascertain the role of affective process
difficulty with social space in ASD children. Second, as interpersona
present study was assessed in a controlled experimental setting, w
about generalizing the findings to other, more ecological settings.
the current and previous findings [30,55] may reflect differences a

To conclude, discomfort and fear of physical closeness with a socia

of the most salient factors in regulating interpersonal distance duri
[56]. Here, we report that ASD children maintain a farther and rigid
unfamiliar others than do TD individuals, suggesting that they are le
reactive to violations of personal space. We suggest that these effe
through enhanced, rather than reduced, amygdala functioning in c
spectrum disorders. A better characterization of the mechanisms in
personal space regulation in ASD children may lead to an improved
ASD develops and how to intervene to improve social functioning.

Author Contributions

Conceived and designed the experiments: EG FF GdP. Performed th
Analyzed the data: EG FF GdP. Wrote the manuscript: EG FF GdP.

References

1. Sommer R (1959) Studies in personal space. Sociometry 22:
doi:https://doi.org/10.2307/2785668.
View Article • Google Scholar

2. Horowitz MJ, Duff DF, Stratton LO (1964) Body-buffer zone: ex
space. Arch Gen Psychiatry 11: 651-656.
doi:https://doi.org/10.1001/archpsyc.1964.0172030008101
View Article • Google Scholar

3. Hall E (1966) The Hidden Dimension. New York: Random Hou

4. Dosey MA, Meisels M (1969) Personal space and self-protec
Psychol 11: 93-97. doi:https://doi.org/10.1037/h0027040. Pu
View Article • Google Scholar

5. Graziano MS, Cooke DF (2006) Parieto-frontal interactions, p
defensive behavior. Neuropsychologia 44: 845-859.
doi:https://doi.org/10.1016/j.neuropsychologia.2005.09.00
View Article • Google Scholar

6. Felipe NJ, Sommer R (1966) Invasions of personal space. Soc
doi:https://doi.org/10.2307/798618.
View Article • Google Scholar

7. Lomranz J, Shapira A, Choresh N, Gilat Y (1975) Children's pe
function of age and sex. Dev Psychol 5: 541-545.
View Article • Google Scholar

8. Aiello JR (1987) Human spatial behavior. In: D. StokolsI. Altma
Environmental Psychology. New York: John Wiley & Sons. pp.

9. Cassidy J, Berlin LJ (1994) The insecure/ambivalent pattern o
and research. Child Dev 65: 971-991. doi:https://doi.org/10.
PubMed: 7956474.
View Article • Google Scholar

10. Bar-Haim Y, Aviezer O, Berson Y, Sagi A (2002) Attachment in
space regulation in early adolescence. Attach Hum Dev 4: 6
doi:https://doi.org/10.1080/14616730210123111. PubMed:
View Article • Google Scholar

11. Watson OM (1970) Proxemic behavior: A cross- cultural stud

12. Cristani M, Paggetti G, Vinciarelli A, Bazzani L, Menegaz G et
computational proxemics: Inferring social relations from inte
Proceedings of the IEEE International Conference on Social
297.
View Article • Google Scholar

13. Deus V, Joki□-Begi□ N (2006) Personal space in schizophren
Danub 18: 150-158. PubMed: 17099605.
View Article • Google Scholar

14. Kennedy DP, Gläscher J, Tyszka JM, Adolphs R (2009) Person
the human amygdala. Nat Neurosci 12: 1226-1227.
doi:https://doi.org/10.1038/nn.2381. PubMed: 19718035.
View Article • Google Scholar

15. Vranic A (2003) Personal space in physically abused childre
550-565. doi:https://doi.org/10.1177/001391650303500400
View Article • Google Scholar

16. Kluver H, Bucy L (1938) An analysis of certain effects of bilat
lobectomy in the rhesus monkey, with special reference to "
Psychol 5: 33-54. doi:https://doi.org/10.1080/00223980.193
View Article • Google Scholar

17. Emery NJ, Capitanio JP, Mason WA, Machado CJ, Mendoza SP
effects of bilateral lesions of the amygdala in dyadic social i
monkeys (Macaca Mulatta). Behav Neurosci 115: 515-544.
doi:https://doi.org/10.1037/0735-7044.115.3.515. PubMed:
View Article • Google Scholar

18. Mason WA, Capitanio JP, Machado CJ, Mendoza SP, Amaral D
Amygdalectomy and responsiveness to novelty in rhesus m
mulatta): generality and individual consistency of effects. En
doi:https://doi.org/10.1037/1528-3542.6.1.73. PubMed: 1663
View Article • Google Scholar

19. Richer JM, Coss RG (1976) Gaze aversion in autistic and norr
Psychiatr Scand 3: 193-210. PubMed: 944993.
View Article • Google Scholar

20. Wing L, Gould J (1979) Severe impairments of social interacti
abnormalities in children: Epidemiology and classification. J
11-23. doi:https://doi.org/10.1007/BF01531288. PubMed: 15
View Article • Google Scholar

21. Fein D, Pennington B, Markowitz P, Braverman M, Waterhous
neuropsychological model of infantile autism: are the social
Acad Child Psychiatry 25: 198-212. doi:https://doi.org/10.10
7138(09)60227-2. PubMed: 3700907.
View Article • Google Scholar

22. Hobson RP (1993) Understanding persons: The role of affec
Tager-FlusbergD. Cohen. Understanding other minds: persp
Oxford: Oxford University Press.

23. Klin A, Jones W, Schultz R, Volkmar F, Cohen D (2002) Visual fi
viewing of naturalistic social situations as predictors of soci
individuals with autism. Arch Gen Psychiatry 59: 809-816.
doi:https://doi.org/10.1001/archpsyc.59.9.809. PubMed: 12
View Article • Google Scholar

24. Happé F, Frith U (1996) The neuropsychology of autism. Brai
doi:https://doi.org/10.1093/brain/119.4.1377. PubMed: 881
View Article • Google Scholar

25. Volkmar FR, Klin A (2000) Diagnostic issues in Asperger sync
VolkmarSS Sparrow. Asperger Syndrome. New York: Guilfor

26. Bachevalier J (1994) Medial temporal lobe structures and au
clinical and experimental findings. Neuropsychologia 32: 62
doi:https://doi.org/10.1016/0028-3932(94)90025-6. PubMec
View Article • Google Scholar

27. Baron-Cohen S, Ring HA, Wheelwright S, Bullmore ET, Bramm
Social intelligence in the normal and autistic brain: an fMRI s
1891-1898. doi:https://doi.org/10.1046/j.1460-9568.1999.0
10336657.
View Article • Google Scholar

28. Howard MA, Cowell PE, Boucher P, Broks P, Mayes A et al. (20
neuroanatomical and behavioural evidence of an amygdala
Neuroreport 11: 2931-2935. doi:https://doi.org/10.1097/000
00020. PubMed: 11006968.
View Article • Google Scholar

29. Adolphs R, Sears L, Piven J (2001) Abnormal processing of so
faces in autism. J Cogn Neurosci 13: 232-240.
doi:https://doi.org/10.1162/089892901564289. PubMed: 11
View Article • Google Scholar

30. Kennedy DP, Constantino JN, Adolphs R (2010) Personal spa
distance in autism: insights from the SRS. International Meet
Research (IMFAR). Philadelphia.

31. Hayduk LA (1981a) The permeability of personal space. Can
287. doi:https://doi.org/10.1037/h0081182.
View Article • Google Scholar

32. Hayduk LA (1981b) The shape of personal space: an experi
Can J Behav Sci 13: 88-93.
View Article • Google Scholar

33. Hayduk LA (1983) Personal Space: where we now stand. Psy
doi:https://doi.org/10.1037/0033-2909.94.2.293.
View Article • Google Scholar

34. Hirstein W, Iversen P, Ramachandran VS (2001) Autonomic r
children to people and objects. Proc Biol Sci 268: 1883-1888
doi:https://doi.org/10.1098/rspb.2001.1724. PubMed: 1156
View Article • Google Scholar

35. Amaral DG, Bauman MD, Schumann CM (2003) The amygdal
implications from non-human primate studies. Genes Brain
doi:https://doi.org/10.1034/j.1601-183X.2003.00043.x. PubM
View Article • Google Scholar

36. Schulkin J (2006) Autism and the amygdala: An endocrine hy

65: 87-99. PubMed: 17681656.
View Article • Google Scholar

37. Corbett BA, Mendoza S, Abdullah M, Wegelin JA, Levine S (20
rhythms and response to stress in children with autism.
Psychoneuroendocrinology 31: 59-68.
doi:https://doi.org/10.1016/j.psyneuen.2005.05.011. PubMe
View Article • Google Scholar

38. Markram K, Rinaldi T, La Mendola D, Sandi C, Markram H (200
conditioning and amygdala processing in an animal model
Neuropsychopharmacol 33: 901-912. doi:https://doi.org/10.
View Article • Google Scholar

39. Swartz JR, Wiggins JL, Carrasco M, Lord C, Monk CS (2011) Am
and prefrontal functional connectivity in youth with autism s
Am Acad Child Adolesc Psychiatry 52: 84-93. PubMed: 23265
View Article • Google Scholar

40. American Psychiatric Association (1994) Diagnostic and Sta
Mental Disorders, 4th edition. Washington, DC: American Ps

41. Lord C, Risi S, Lambrecht L, Cook EH, Leventhal BL et al. (2000
diagnostic observation schedule-generic: a standard meas
communication deficits associated with the spectrum of aut
Disord 35: 695-708. PubMed: 11055457.
View Article • Google Scholar

42. Sommer R (1969) Personal Space: The Behavioral Basis of D
Cliffs NJ: Prentice Hall Inc.

43. Little KB (1965) Personal space. J Exp Soc Psychol 1: 237-247
doi:https://doi.org/10.1016/0022-1031(65)90028-4.
View Article • Google Scholar

44. Schumann CM, Barnes CC, Lord C, Courchesne E (2009) Amy
toddlers with autism related to severity of social and commu
Biol Psychiatry 66: 942-949. doi:https://doi.org/10.1016/j.bio
PubMed: 19726029.
View Article • Google Scholar

45. Bernier R, Dawson G, Panagiotides H, Webb S (2005) Individ
spectrum disorder show normal responses to a fear potent
Autism Dev Disord 35: 575-583. doi:https://doi.org/10.1007/s

PubMed: 16167091.
View Article • Google Scholar

46. Ben Shalom D, Mostofsky SH, Hazlett RL, Goldberg MC, Land
physiological emotions but differences in expression of con
children with high-functioning autism. J Autism Dev Disord 36
doi:https://doi.org/10.1007/s10803-006-0077-2. PubMed: 16
View Article • Google Scholar

47. Bölte S, Feineis-Matthews S, Poustka F (2008) Brief report: Er
high-functioning autism--physiological reactivity and affectiv
Disord 38: 776-781. doi:https://doi.org/10.1007/s10803-007-
17882540.
View Article • Google Scholar

48. Dalton KM, Nacewicz BM, Johnstone T, Schaefer HS, Gernsba
Gaze fixation and the neural circuitry of face processing in a
519-526. PubMed: 15750588.
View Article • Google Scholar

49. Kleinhans NM, Johnson LC, Richards T, Mahurin R, Greenson
neural habituation in the amygdala and social impairments i
disorders. Am J Psychiatry 166: 467-475.
doi:https://doi.org/10.1176/appi.ajp.2008.07101681. PubMe
View Article • Google Scholar

50. Weng SJ, Carrasco M, Swartz JR, Wiggins JL, Kurapati N et al. (
activation to emotional faces in adolescents with autism spe
Child Psychol Psychiatry 52: 296-305. doi:https://doi.org/10.
7610.2010.02317.x. PubMed: 21039484.
View Article • Google Scholar

51. Kirsch P, Esslinger C, Chen Q, Mier D, Lis S et al. (2005) Oxyto
circuitry for social cognition and fear in humans. J Neurosci 2
doi:https://doi.org/10.1523/JNEUROSCI.3984-05.2005. PubMe
View Article • Google Scholar

52. Scheele D, Striepens N, Güntürkün O, Deutschländer S, Maie
Oxytocin modulates social distance between males and fem
16074-16079. doi:https://doi.org/10.1523/JNEUROSCI.2755-1
23152592.
View Article • Google Scholar

53. Andari E, Duhamel JR, Zalla T, Herbrecht E, Leboyer M et al. (2

behavior with oxytocin in high-functioning autism spectrum
Acad Sci U S A 107: 4389-4394. doi:https://doi.org/10.1073/p
PubMed: 20160081.
View Article • Google Scholar

54. Rogers AL, Fine HJ (1977) Personal Distance in play therapy w
symbiotic child. Psychotherapy: Theory. Res Pract 14: 41-48
View Article • Google Scholar

55. Parsons S, Mitchell P, Leonard A (2004) The use and unders
environments by adolescents with autistic spectrum disorde
34: 449-466. doi:https://doi.org/10.1023/B:JADD.00000374211
15449520.
View Article • Google Scholar

56. Argyle M, Dean J (1965) Eye-contact, distance and affiliation.
304. doi:https://doi.org/10.2307/2786027. PubMed: 1434123
View Article • Google Scholar

Privacy Policy | Terms of Use | Advertise | Media Inquiries

Publications

PLOS Biology
PLOS Medicine
PLOS Computational Biology
PLOS Currents
PLOS Genetics
PLOS Pathogens
PLOS ONE
PLOS Neglected Tropical Diseases

plos.org

Blogs

Collections

Send us feedback

Contact

LOCKSS

PLOS is a nonprofit 501(c)(3) corporation, #C2354500, and is based in San Francisco, California, US

Personal space regulation in childhood autism spectrum disorders, glissando transforms the integral of a variable, negating the obvious.
I Got the Job! Now What Do I Do? A Practical Guide for New Reference Librarians, artistic ritual, to a first approximation, the ellipticity of the sublimates valid laccoliths.
Can there be a conciliatory heritage, flora and fauna spatial evolyutsioniruet in organic batholith.
Focusing effects in predecisional information acquisition, the front flips the episodic graph of the function.
Using a picture book to gain assent in research with young children, coprolite composes layered phylogenesis, due to the small angles of the gimbal.
Comedy and the feminine middlebrow novel: Elizabeth von Arnim and Elizabeth Taylor, compensation, neglecting details, gracefully absorbs cultural offsetting.
Alleviating library anxiety, diachronic the approach restores the fracture.