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EMPIRICAL REPORT

Attitudes Toward Neuroscience Education Among Psychiatry Residents and Fellows

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Abstract
Objective The purpose of this study is to assess the attitudes of psychiatry trainees toward neuroscience education in psychiatry residency and subsequent training in order to inform neuroscience education approaches in the future.
Methods This online survey was designed to capture demographic information, self-assessed neuroscience knowledge, attitudes toward neuroscience education, preferences in learning modalities, and interest in specific neuroscience topics. Volunteers were identified through the American Psychiatric Association, which invited 2,563 psychiatry trainees among their members.
Results Four hundred thirty-six trainees completed the survey. Nearly all agreed that there is a need for more neuroscience education in psychiatry residency training (94 %) and that neuroscience education could help destigmatize mental illness (91 %). Nearly all (94 %) expressed interest in attending a 3-day course on neuroscience. Many neuroscience topics and modes of learning were viewed favorably by participants. Residents in their first 2 years of training expressed attitudes similar to those of more advanced residents and fellows. Some differences were found based on the level of interest in a future academic role.
Conclusions This web-based study demonstrates that psychiatry residents see neuroscience education as important in their training and worthy of greater attention. Our results suggest potential opportunities for advancing neuroscience education.

Keywords Neuroscience · Education · Psychiatry · Residency

Psychiatry is a medical specialty concerned with behavioral, emotional, and cognitive disorders mediated by physiological processes in the brain. This definition of the field has endured since the time of Freud [1] and yet, in part because neuroscience itself was in its infancy, the neurobiological formulation of mental illness has not become a dominant force in our field until very recently. In the first half of the twentieth century, a number of psychological theories emerged and drove scientific developments in the field. In 1950, the synthesis of chlorpromazine marked the beginning of the modern era of psychopharmacology [2], stimulating renewed interest in neuroscience research. More breakthroughs followed in psychopharmacology, including discovery of antidepressants, mood stabilizers, stimulants, and other antipsychotic medications. In the past 20 years, significant advances in molecular biology, genetics, and neuroimaging have furthered our understanding of the neurobiological bases of cognition, emotion, behavior, and social processes. Accordingly, neuroscience has matured enough to allow psychiatry to be grounded in clinical neuroscience [3, 4]. In 2009, the National Institute of Mental Health (NIMH) launched the Research Domain Criteria (RDoC) project to "develop, for research purposes, new ways of classifying mental disorders based on dimensions of observable behavior and neurobiological measures" [5–7]. Therefore, a major paradigm shift in classifying, studying, and understanding psychiatric disorders is anticipated.

The training of psychiatrists in neuroscience, however, appears to lag behind the advances in neuroscience research. Further, compared to some medical specialties, basic and translational neuroscience education in psychiatry seems to be limited [8].

In this project, we sought to assess attitudes toward neuroscience among psychiatrists-in-training. We further wished to learn how neuroscience education may be best accomplished

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with respect to domains of interest and modes of learning, as perceived by trainees. We hypothesized that psychiatrists-in-training would perceive their neuroscience education as intrinsically valuable but insufficient, that they would be willing to spend significant time and energy to learn about neuroscience, and that they could identify areas of neuroscience that are particularly interesting and teaching methods that they prefer. We sought to determine whether the stages of training (i.e., the first 2 years of residency vs. later years of residency and fellowship) and level of interest in a future academic role were associated with differences in attitude, willingness to engage in neuroscience learning, or topics of interest and preferred teaching approaches. Finally, our aim was to understand the attitudes of psychiatrists regarding the potential value that neuroscience education has to offer clinical practice, namely, to help inform patient education, to combat stigma, and to accelerate advances in diagnosis and treatment of mental disorders.

Methods

The objective of this study was to assess the attitudes of psychiatry residents and fellows toward neuroscience education in order to inform neuroscience education approaches in the future. The survey protocol conformed to institutional requirements for human studies and was formally deemed exempt per the Institutional Review Board (IRB) at Stanford University. No protected health information was collected in the survey. This study was executed in two phases: (1) pilot phase and (2) web-based survey for psychiatry trainees through the American Psychiatric Association (APA). In this investigation, we defined "neuroscience" as the study of the nervous system and behavior using cellular and molecular biology, animal models, neuroanatomy, neuroimaging, genetics, neuropsychology (cognitive neuroscience), and basic pharmacology (but not clinical pharmacology).

Pilot Survey Selected 3rd-year psychiatry residents at Stanford University Department of Psychiatry and Behavioral Sciences were invited to complete a web-based survey to establish feasibility of the study in July 2011. We determined that participants took approximately 5 min or less to complete the survey. Furthermore, these residents commented on the clarity of the questions. The comments were then used to optimize the national online survey.

Participants Psychiatry trainees were defined as residents and fellows enrolled in a training program in a department of psychiatry at the time of completion of the online survey. In March 2012, the APA invited 1,000 randomly selected members-in-training via e-mail to complete an online version of the SENS survey. To improve our response rate, we repeated the study in October 2012. In the second round of this survey, the APA invited all psychiatry trainees who were not invited in March 2012 (N=2,563) via e-mail to complete the SENS survey. To further increase the response rate, a raffle for an Apple iPad was held among participants of this round of the survey. The survey was closed 30 days after the initial invitation was sent. Responses received in the October 2012 survey were used for data analysis.

Measures The survey contained 42 items. The questions consisted of Likert-scaled items, agree/disagree items, categorical response items, and an open-ended item asking for additional comments on neuroscience education. The survey was designed to capture three main types of information: (1) demographic information (gender, age, level of psychiatric training, advanced scientific training, scope of psychiatric practice), (2) self-assessments of knowledge in neuroscience and its clinical applications, and (3) attitudes toward neuroscience and neuroscience education (need for more neuroscience education in residency and beyond, neuroscience areas of interest, preferred pedagogical methods, prediction on how soon neuroscience will yield significant new interventions, role of neuroscience in reducing stigma for mental illness). Participants were asked to choose areas of interest among domains of neuroscience that reflect research tools and levels of study commonly used in basic and translational neuroscience including: basic pharmacology (as opposed to clinical pharmacology), neuroimaging/neuroanatomy, neural circuits (macro and microcircuits), genetics and genomics, cellular and molecular biology, and animal models. Participant were also asked about their interest in learning more about selected neuroscience topics relevant to psychiatry including: emotion regulation, attention/cognition, reward systems, neuroplasticity and psychotherapy, perceptual systems, neurobiology of attachment, fear/extinction, pain perception, developmental neurobiology, basic research-driven drug development, and epigenetics. Finally, in order to assess the level of interest in neuroscience education, we asked psychiatry trainees whether they would be interested in taking a 3-day neuroscience course.

Data Analysis Data analysis was conducted with SPSS 19 (SPSS Inc., Chicago, IL). Descriptive statistics were used to characterize percent response as well as questions on preference for neuroscience learning modalities and domains/topics of interest in neuroscience. For conceptually related sets of items regarding (a) self-assessment of knowledge of neuroscience and (b) attitudes toward neuroscience, we conducted repeated-measures *item* (within-subjects repeated measures) × *gender* × *participant training level* (*PGY 1 and 2* vs. *PGY 3*, *4*, *and fellowship years*) MANOVAs. If $p<0.05$ in Box's test of equality of covariance matrices, then statistical effect with multivariate tests on *gender*, *participant role*, and *gender* ×

participant training level was examined. If $p<0.05$ for either Pillai's trace and Wilks' lambda, then ANOVAs for between-subjects effects for specific *items* were performed. To explore the data with less stringency, we have also performed Mann-Whitney tests on individual questions regarding (a) and (b).

In addition to the above analyses for all participants, we have also performed Mann-Whitney tests and one-way ANOVAs for individual items comparing "academically oriented trainees" (defined as trainees who indicated that they were interested in teaching medical students and residents with more than 5 % of their efforts) with the rest of the study participants.

Results

Characteristics of Respondents The trainees who responded to this survey in October 2012 represented 139 psychiatry residencies or fellowship programs listed in American Association of Medical Colleges as well as 50 unlisted programs. The participants represented trainees from all 4 years of residency and a variety of fellowships in psychiatry (child and adolescent psychiatry, geriatric psychiatry, psychosomatic medicine, forensic psychiatry, addiction psychiatry, sleep medicine, research).

The response rate for this survey was 18 % (462/2563). Among the 462 trainee survey respondents, 14 identified themselves as practicing psychiatrists instead of trainees. These individuals were eliminated in the current study, producing a final analytic set of 448 study volunteers (Table 1). One hundred fifty-three respondents were PGY 1 and PGY 2 residents, and 278 were PGY 3, PGY 4, and fellow respondents.

Most trainees (93 %) responded to the survey were younger than 40 years old. There were more female (54 %) than male respondents. Further, a small portion of the participants held non-MD medical degrees (12 % for DO and 11 % for MBBS). Based on the resident census report for 2011–2012 published by the APA, 92 % of all US psychiatry residents were younger than 40 years old; 55 % were female [9]. The same report also indicated that 11 % of the PGY1 psychiatry residents held DO degrees, but there were no specific data for MBBS.

Most of the respondents (67 %) anticipated that their scope of practice would encompass mostly psychopharmacology (i.e., 75 or 100 % psychopharmacology). Only 5 % of the responded trainees anticipated that their scope of practice would have more psychotherapy than psychopharmacology. Most trainee respondents (94 %) planned to be involved in teaching residents and/or medical students. About two thirds (62 %) of the participants indicated that they planned to be involved in this activity with more than 5 % of their efforts. We will refer to this group as academically oriented trainees (AOTs) from here on.

Self-assessed Knowledge of Neuroscience Most (62 %) of the trainees rated their quality of neuroscience education in their residency program as "Adequate," "More than adequate," or "Excellent" (Table 2). The same percentage of trainees rated their fund of knowledge as "Adequate" to "Excellent" as well. Nearly three-quarters (72 %) of the participants agreed that they are comfortable discussing neuroscience findings with their patients. Box's test of equality of covariance matrices showed significance ($p<0.001$) in this group of questions with significance in Pillai's trace ($p<0.000001$) and Wilks' lambda ($p<0.000001$).

No significant difference in the self-assessments in neuroscience education was found between the two trainee groups. Mann-Whitney tests revealed that more junior trainees (as compared to senior trainees) indicated that their attendings were more comfortable discussing neuroscience ($p=0.037$); no statistically significant difference between the two trainee groups was found for the other three questions.

With respect to gender, compared to male trainees, female trainees rated higher in the quality of their neuroscience education they received in residency ($p=0.016$). However, female trainees felt less comfortable than male trainees in discussing findings with their patients ($p=0.00011$), and they rated lower in their fund of knowledge in neuroscience ($p=0.011$). No significant difference in the self-assessments in neuroscience education was found between AOTs and their peers in this study.

Attitudes Toward Neuroscience Education in Psychiatry Participants in all groups showed overwhelming agreement on the need for promoting neuroscience education in psychiatry, including 94 % of participants overall (96 % of junior trainees and 93 % of senior trainees). Similarly, 91 % of trainees agreed that greater public understanding of neuroscience will help efforts to destigmatize mental illness, including 93 % of junior trainees and 90 % of senior trainees. A majority (70 %) of participants overall indicated that advances in neuroscience would lead to discovery of new treatments or personalized medicine in 5 or 10 years. The vast majority (94 %) of participants showed interest in taking a 3-day course in the neuroscience of psychiatry.

MANOVA analyses of this category of questions showed no statistical difference between genders and among training levels. Mann-Whitney tests revealed that more junior trainees felt strongly that greater public understanding of neuroscience would help in reducing stigma for patients with mental illness ($p=0.044$). No significant difference in the responses to the questions regarding attitudes toward neuroscience education was found between AOTs and the rest of the participants in this study.

Table 1 Characteristics of study samples by training level

Characteristics	Junior trainees (PGY1 and 2; n=153)		Senior trainees (PGY3, 4, and fellows; n=278)		Compare junior and senior psychiatry trainees[a]	
	%	Number	%	Number	z	p
Age						
25–30	58	88	38	106	−3.254	0.0011*
31–40	34	52	55	154		
41–50	8	12	5	15		
51–60	1	1	1	3		
Gender						
Male	45	69	47	131	−0.403	0.683
Female	55	84	53	147		
What advanced degrees do you have? (check all that apply)						
MD	73	111	84	232	N/A	N/A
DO	15	23	10	29		
MBBS	16	24	9	24		
PhD or equivalent	5	8	7	19		
Master's	9	14	15	42		
Other advanced degree	3	5	1	2		
Scope of clinical practice—psychopharmacology (%), psychotherapy (%)						
0 %, 100 %	0	0	0	0	−0.853	0.394
25 %, 75 %	6	9	5	13		
50 %, 50 %	29	44	28	79		
75 %, 25 %	61	93	59	168		
100 %, 0 %	4	6	9	24		
Do you plan to be involved in teaching residents and/or medical students?						
Yes (<5 %)	34	51	31	85	−0.811	0.418
Yes (>5 %)	61	92	63	174		
No	6	9	7	19		

*p<0.005

[a] Statistical test: Mann-Whitney test

Preference for Neuroscience Learning Modalities Overall, trainees found that case conferences, ward or clinic-based teaching as well as expert-led small group discussions are most helpful and they found journal club and internet-based modules least helpful (Table 3). No statistical difference in the preference in neuroscience learning modalities was found between junior and senior trainees. However, AOTs rated expert-led discussions (p=0.027) and journal club (p=0.037) higher than the rest of the participants.

Domains and Topics of Interest in Neuroscience Modalities Among domains of neuroscience, basic pharmacology, neuroimaging, and neural circuits were found to be most important, while animal models were rated as least important (Table 4). No statistical difference in the preference in the domains of interest was found between junior and senior trainees. AOTs rated almost all domains of neuroscience higher than the rest of the study participants.

Among specific neuroscience topics, emotion regulation, attention/cognition, and reward systems were regarded as the most important topics, while epigenetics, basic research-driven drug development, developmental neurobiology, and pain perception were rated least important. Compared to junior trainees, senior trainees rated neuroscience topics as more important, with statistical differences achieved for neurobiology of attachment, emotion regulation, and epigenetics. AOTs also rated higher in the neuroscience topics (especially for attention/cognition, neurobiology of attachment, and developmental neurobiology) than non-AOTs.

Discussion

To our knowledge, this study is the first to report the remarkably positive attitudes toward neuroscience education among

Table 2 Self-evaluation on knowledge in neuroscience

Question	Junior trainees (PGY1 and 2; n=153)		Senior trainees (PGY3, 4, and fellows; n=278)		Compare junior and senior psychiatry trainees[a]		Male trainees (n=205)		Female trainees (n=250)		Compare male and female trainees[a]	
	%	Number	%	Number	z	p	%	Number	%	Number	z	p
Please rate the quality of neuroscience education in your residency program												
Inadequate	4	6	7	19	−1.053	0.292	9	18	9	9	−2.405	0.016*
Less than adequate	29	44	35	95			33	68	33	83		
Adequate	52	79	42	116			44	91	46	114		
More than adequate	14	21	12	34			12	24	14	36		
Excellent	1	1	4	11			2	4	3	8		
Please rate your fund of knowledge in neuroscience												
Inadequate	1	2	3	7	−1.895	0.061	2	5	2	6	−2.548	0.011*
Less than adequate	42	64	33	91			31	63	41	103		
Adequate	47	71	50	136			48	99	46	116		
More than adequate	8	12	10	27			13	27	7	17		
Excellent	1	2	5	14			5	11	3	8		
"I am comfortable discussing neuroscience findings with my patients." (e.g., information regarding their disorder, treatment options, new research findings, etc.)												
Strongly agree	7	11	13	36	−1.873	0.061	13	27	10	25	−3.871	0.00011**
Agree	60	90	62	170			67	137	55	137		
Disagree	32	48	24	66			19	38	33	83		
Strongly disagree	1	1	1	3			1	2	2	5		
"My attendings and clinical teachers are comfortable discussing neuroscience." (e.g., information regarding disorders, treatment options, new research findings, etc.)												
Strongly agree	20	30	8	48	−2.085	0.037*	16	32	20	49	−1.685	0.092
Agree	65	98	58	160			58	119	61	152		
Disagree	14	21	22	61			26	53	16	40		
Strongly disagree	1	1	2	6			0	0	4	9		

*p<0.05; **p<0.005

[a] Statistical test: Mann-Whitney test

psychiatry trainees. These results are especially motivating as clinical neuroscientists are leading the field of psychiatry in establishing its foundation in clinical neuroscience as well as serving our psychiatrists-in-training who recognize the importance of neuroscience to their education. We found that the stage of training was not associated with the trainees' overall attitudes toward neuroscience education. Nearly all respondents (94 %) agreed with the need for more neuroscience education in psychiatry residency training. A large majority of psychiatry trainees (94 %) are interested in taking a 3-day course in neuroscience as part of their education. In addition to the overwhelming interest in learning neuroscience, we found that most psychiatry trainees (70 % overall) felt that neuroscience would lead to the discovery of new treatments or personalized medicines in 5 or 10 years. The anticipated developments of new treatments, advances in neuroscience have clear social impact [10, 11], including the potential to destigmatize mental illness (supported by 93 % of junior trainees and 89 % of senior trainees in this survey). A paradigm shift in classifying, studying, and understanding mental disorders based on neuroscience research is anticipated [3, 4, 12]. It is therefore helpful to know that psychiatry trainees are interested in learning the basic and translational science relevant to psychiatry.

In this study, participants found didactics and expert-led small group discussions to be the most helpful modalities of learning neuroscience while journal club and internet-based modules were regarded as least helpful. In contrast, a recent survey targeting psychiatry residency program directors conducted by the American Association of Directors of Psychiatry Residency Training (AADPRT) found that there was a high interest in portable neuroscience modules (i.e., internet-based modules) among the training directors [13]. This discrepency may be accounted for by the different survey population.

In 2006, Roffman et al. surveyed the same group (AADPRT) found that the amount of neuroscience in

Table 3 Rating of neuroscience learning modalities by level of training

Learning modality	All trainees (n=431)	Junior trainees (PGY1 and 2; n=153)	Senior trainees (PGY3, 4, and fellows; n=278)	p value[c] (junior vs. senior trainees)	Non-AOTs[a] (n=165)	AOTs[a] (n=266)	p value[c] (AOTs vs. non-AOTs)
	Mean ± standard deviation[b]						
Case conferences, ward or clinic-based teaching	4.02±0.90	4.05±0.91	4.00±0.90	0.614	3.96±0.95	4.05±0.87	0.287
Expert-led small group discussions	3.94±0.99	3.92±1.03	3.95±0.96	0.778	3.81±1.04	4.02±0.95	0.027*
Formal didactics	3.74±0.96	3.70±0.97	3.76±0.95	0.513	3.72±1.03	3.76±0.91	0.670
Other independent learning	3.59±1.03	3.58±1.02	3.60±1.04	0.855	3.56±1.04	3.62±1.03	0.565
Grand rounds or conference symposia/talks	3.39±0.98	3.35±1.04	3.41±0.96	0.541	3.33±1.05	3.43±0.94	0.282
Journal club	3.30±0.99	3.38±0.98	3.26±0.99	0.227	3.18±1.04	3.38±0.95	0.037*
Internet-based modules	3.16±1.06	3.12±1.03	3.18±1.08	0.561	3.05±1.10	3.22±1.03	0.111

*p<0.05

[a] Academically oriented trainees (AOTs) answered "Yes (>5 %)" to the question "Do you plan to be involved in teaching residents and/or medical students?" Non-AOTs answered either "No" or "Yes (<5 %)" to this question

[b] *1* least helpful, *2* not quite helpful, *3* moderately helpful, *4* helpful, *5* most helpful

[c] Statistical test: one-way ANOVA

residency curricula had increased over the previous 5 years [8]. In addition, they expected further increases in the amount of neuroscience teaching in the subsequent 5 years. However, despite the reported increase in the amount of neuroscience in residency, the competency in interpreting scientific findings among residents and educators in psychiatry was disappointing. In 2010, Hoop et al. reported that only 42 % of educators and 29 % of residents felt competent to interpret papers on psychiatric genetics [14]. Interestingly, our study revealed a different result—the majority of residents felt comfortable discussing neuroscience findings with their patients. However, senior trainees did not feel more comfortable discussing neuroscience findings with their patients. Similarly, reports from senior trainees did not reflect more adequate fund of knowledge than junior trainees. In this study, a significant percentage (39 %) of trainees indicated that their neuroscience training was "inadequate" or "less than adequate." Furthermore, self-assessments of competence are often inflated [15, 16]. Therefore, a portion of the 45 % of respondents who responded that their neuroscience training was "adequate" may have less than adequate training. Overall, these observations are concerning because they imply that the trainees have desires to learn neuroscience, but the teaching has not enhanced their ability to be truly competent in using the material.

Despite the concern about the current effectiveness of neuroscience education, psychiatry trainees (especially AOTs) have tremendous interest in learning neuroscience. The enthusiasm from the AOTs was reflected from their levels of interest in specific domains and topics of neuroscience. Would AOTs benefit from even more neuroscience teaching? Would establishing a neuropsychiatry track in residency programs be helpful for AOTs and the field of psychiatry? We do not have answers for these questions at this point, but we find these questions worthy of further investigation.

Strengths of this study include careful instrument development, the observation that residents from a large number of psychiatry training programs (n=139) across the country, and a relatively large absolute number of respondents participated (n=436). Our study nevertheless has the limitation of a low response rate. Recently published surveys of psychiatrists [17–19] and psychiatry residents [14, 20–22] have reported highly variable response rates (20–47 % and 20–65 %, respectively) and lower sample sizes (122–236 and 22–237, respectively). Though typical of web-based surveys [23] of busy health professionals [24], the results of our project may be biased and the reader should interpret our findings accordingly.

This study demonstrated an overwhelming interest from a sample of psychiatry trainees, across all levels, for more neuroscience education. Our work also suggests that the effectiveness of current neuroscience education in psychiatry residency programs in the USA may be a concern. These results, if confirmed, point to an urgent need to improve neuroscience curricula. In the current study, we have identified specific preferences in learning modalities and neuroscience topics among AOTs and non-AOTs. These preferences are important in terms of reinforcing and supporting the interests of motivated learners but should also inspire further study as we pave the way for targeted strategies to more effectively disseminate neuroscience knowledge to trainees in psychiatry.

Table 4 Responses from participants by level of training to the questions: (1) "For each domain of neuroscience please indicate how salient, and thus important, it is to teach." (2) "Beyond learning about the neurobiology of individual diagnoses, please rate your interest in learning about the following neuroscience domains which cut across different psychiatric diagnoses"

Question	All trainees (n=431)	Junior trainees (PGY1 and 2; n=147)	Senior trainees (PGY3, 4, and fellows; n=272)	p value[c] (junior vs. senior trainees)	Non-AOTs[a] (n=165)	AOTs[a] (n=266)	p value[c] (AOTs vs. non-AOTs)	Rank (AOTs)
	Mean ± standard deviation[b]							
(1) Domains of neuroscience								
Basic pharmacology	4.38±1.01	4.29±1.12	4.43±0.94	0.544	4.32±1.17	4.42±0.89	0.290	1
Neuroimaging/neuroanatomy	4.26±1.03	4.23±1.14	4.27±0.96	0.443	4.07±1.21	4.37±0.88	0.0036**	2
Neural circuits (macro and microcircuits)	4.21±1.03	4.11±1.16	4.26±0.96	0.188	4.04±1.20	4.31±0.91	0.0083*	3
Genetics and genomics	3.69±1.02	3.65±1.11	3.72±0.97	0.550	3.55±1.15	3.79±0.92	0.017*	4
Cellular and molecular biology	3.61±1.06	3.56±1.08	3.64±1.05	0.692	3.46±1.13	3.71±1.00	0.017*	5
Animal models	3.11±1.02	3.07±1.11	3.13±0.96	0.146	2.89±1.05	3.25±0.97	0.00035**	6
(2) Specific neuroscience topics								
Emotion regulation	4.31±1.35	4.13±1.44	4.41±1.28	0.039*	4.21±1.43	4.38±1.29	0.203	1
Attention/cognition	4.27±1.16	4.21±1.22	4.31±1.12	0.407	4.10±1.27	4.38±1.07	0.017*	1
Reward systems	4.26±1.14	4.10±1.20	4.35±1.09	0.026*	4.18±1.24	4.31±1.07	0.248	3
Neuroplasticity and psychotherapy	4.12±1.33	4.05±1.46	4.16±1.26	0.388	3.99±1.48	3.93±1.27	0.104	5
Perceptual systems	3.91±1.24	3.76±1.34	3.99±1.17	0.067	3.88±1.30	3.93±1.19	0.722	5
Neurobiology of attachment	3.88±1.36	3.58±1.41	4.04±1.31	0.001**	3.68±1.45	4.00±1.29	0.021*	4
Fear/extinction	3.84±1.18	3.71±1.26	3.91±1.13	0.095	3.75±1.22	3.90±1.15	0.190	8
Pain perception	3.77±1.30	3.65±1.35	3.83±1.27	0.152	3.69±1.34	3.82±1.27	0.332	9
Developmental neurobiology	3.76±1.36	3.67±1.35	3.81±1.37	0.322	3.48±1.47	3.93±1.27	0.00088**	5
Basic research-driven drug development	3.55±1.31	3.50±1.40	3.59±1.27	0.498	3.45±1.35	3.62±1.29	0.187	10
Epigenetics	3.47±1.45	3.29±1.45	3.58±1.45	0.049*	3.32±1.53	3.57±1.40	0.075	11

*p<0.05; **p<0.005

[a] Academically oriented trainees (AOTs) answered "Yes (>5 %)" to the question "Do you plan to be involved in teaching residents and/or medical students?" Non-AOTs answered either "No" or "Yes (<5 %)" to this question

[b] *1* unimportant, *2* of little importance, *3* moderately important, *4* important, *5* very important

[c] Statistical test: one-way ANOVA

Implications for Educators

- Psychiatry trainees, and especially those who are academically oriented, are ready and willing to learn more neuroscience during residency.
- Devising an approach to teach neuroscience-based case formulations may be helpful for trainees.
- Expanding core competencies in neuroscience may be a priority for psychiatry residency and fellowship programs.

Implications for Academic Leaders

- Establishing a neuropsychiatry track in residency programs may be helpful to advance the field of psychiatry.
- Facilitating the evolution of departmental culture to apply neuroscience to clinical settings may be helpful to advance the field of psychiatry.
- Investing on the infrastructure for more neuroscience education (e.g., case conferences, ward or clinic-based teaching, expert-led small group discussions) can help educators to train residents and fellows.

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