SFARI: measuring impact of funding

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SFARI Strategic Priorities:

Identify risk factors whether genetic, environmental or epidemiological.

Use non-human organisms to understand how these risk factors alter brain function and animal behavior.

Promote preclinical and clinical investigations to improve autism diagnosis & therapy.

Promote knowledge dissemination to increase the quality of autism-relevant science.

Mission: improve the understanding, diagnosis and treatment of autism spectrum disorders (ASD) by funding innovative research of the highest quality and relevance.
SFARI Support for Autism Research:

- 2017 budget: **$75 million**
- Since launch in 2003: **>$380 million** in external research support
- **>400 investigators**
- Scientific Resources

Mission: improve the understanding, diagnosis and treatment of autism spectrum disorders (ASD) by funding innovative research of the highest quality and relevance
In addition to funding autism research, SFARI supports a number of key scientific resources for the autism community:

- Cohorts of well-characterized individuals with autism or with specific genetic alterations
  - Simons Simplex Collection (SSC)
  - Simons Variation in Individuals Project (Simons VIP)
  - SPARK
- Tools that enable researchers to keep track of the genetic risk factors for autism (SFARI Gene)
- Autism rodent models
- Biospecimens (blood, fibroblasts, iPSCs) and data (e.g. imaging, genetic, phenotypic) from our sponsored research projects (available via SFARI Base)
- Postmortem brain tissue for autism research (available through the collaborative network, Autism BrainNet)
- Therapeutics, including R-baclofen, for investigator-initiated studies in humans and animals (available from Clinical Research Associates, L.L.C., an affiliate of the Simons Foundation)
Measuring Impact of Funding

Fall 2017, the SFARI science team began a conversation with SFARI SAB about a ways of modification of the grant mechanisms to maximize SFARI funding/impact in the autism field.

• Metrics Selection
• Bibliometrics : Publications Trajectories and Relative Citation Ratio
• Assessment of Scientific Resources
• Lessons Learned and Recommendations
Metrics Selection

What has been the impact of SFARI funding on the autism field?

- Has the resulting science been impactful on the field?
  
  Relative Citation Ratio (RCR)

- What’s the stickiness factor (i.e., do people we bring in stay in the autism field)?
  
  Publication Trajectory (in progress)
**Relative Citation Ratio (RCR)**

Has science from SFARI funding been impactful on the field?

**RCR**: a field-normalized metric that shows the scientific influence of one or more articles relative to the average NIH-funded paper.

\[
RCR = \frac{Article\ Citation\ Rate}{Expected\ Citation\ Rate}
\]

RCR = 1 \implies 50\% \text{ NIH publications}

Hutchins et al., PLOS Biology 14(9), 2016
How many SFARI publications have an RCR > 1.0

RCR 1.0 = NIH 50th percentile
## SFARI vs. NIH RCR

<table>
<thead>
<tr>
<th>PERCENTILE</th>
<th>99.9</th>
<th>99</th>
<th>95</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>50</th>
<th>40</th>
<th>30</th>
<th>20</th>
<th>10</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIH RCR</td>
<td>38.00</td>
<td>13.11</td>
<td>5.72</td>
<td>3.81</td>
<td>2.39</td>
<td>1.72</td>
<td>1.3</td>
<td>1</td>
<td>0.76</td>
<td>0.56</td>
<td>0.56</td>
<td>0.38</td>
<td>0.20</td>
</tr>
<tr>
<td>SFARI RCR</td>
<td>72.63</td>
<td>33.8</td>
<td>14.32</td>
<td>10.21</td>
<td>5.79</td>
<td>4.19</td>
<td>3.24</td>
<td>2.56</td>
<td>1.9</td>
<td>1.47</td>
<td>1.05</td>
<td>0.63</td>
<td>0.03</td>
</tr>
</tbody>
</table>

## SFARI RCR by award type

<table>
<thead>
<tr>
<th>TYPE OF AWARD</th>
<th>TOTAL RCR</th>
<th># OF PUBS</th>
<th>MEAN RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESEARCH</td>
<td>1460.78</td>
<td>302</td>
<td>4.84</td>
</tr>
<tr>
<td>PILOT</td>
<td>478.35</td>
<td>109</td>
<td>4.39</td>
</tr>
<tr>
<td>EXPLORER</td>
<td>200.45</td>
<td>75</td>
<td>2.67</td>
</tr>
<tr>
<td>TARGETED RFA</td>
<td>65.24</td>
<td>15</td>
<td>4.35</td>
</tr>
</tbody>
</table>
Publication Trajectories (in progress)

Stickiness Factor: Do people brought into field by SFARI stay in the field?

- Pubmed: publications by SFARI investigators from 2002-2018
- Keyword “ASD” or “Autism”
- Plot # publications per year, per investigator
- Plot average number of publications 2 years pre and 5 years post SFARI funding by funding mechanism and year

Engagement and retention
Assessment of Impact of Scientific Resources

- SFARI Research Cohorts
- SFARI Data resources
- Web portals: SFARIGene, Platforms for Visualization and Integration of Genomic Data
SFARI Research Cohorts

Simons Simplex Collection (SSC)
~10,000 individuals

Simons SearchLight (VIP)
~1,500 individuals
SSC Contribution to Autism Research

• Over 150 publications resulting from SSC data
• Researchers have been approved for over 500 requests for SSC resources
  • 280 biospecimen requests
  • 222 genetic data requests, including whole exome and whole genome data
    • Some requests included multiple datasets – Illumina data has been requested 186 times, Nimblegen177, whole genome pilot data 42
  • 14 external research teams have recruited SSC families into new studies
    • SSC sites have also included SSC families in new, local research with topics ranging from adult issues to imaging studies
• Impact locally at SSC institutions: “The SSC literally launched this clinic. We would not have received the administrative and grant support we have today without the solid foundation built using the SSC funding and training. The impact on careers and families’ lives cannot be overstated.”
Recruit, engage, and retain 50,000 individuals with ASD and their biological family members to:

• identify causes of ASD
• enable genotype-driven research
• find better treatments to improve lives

https://sparkforautism.org

Participants
n = 140,869
Participants with ASD
n = 53,786
Completed trios
n = 14,035

Participants invited to participate in at least 1 project
n ≥ 26,000
Participants expressed interest to participate
n ≥ 10,700
# SFARI Data Resources

<table>
<thead>
<tr>
<th>DATA SET</th>
<th>DATA SIZE</th>
<th>ACCESS</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC Whole Exome sequencing, 2014</td>
<td>~10,000 samples, 120Tb</td>
<td>S3@AWS Flatiron Institute FNAL</td>
<td>Iossifov et al; (2014) Krumm et al, (2015)</td>
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<tr>
<td>SSC Whole Genome Data</td>
<td>~2000 samples, 300Tb</td>
<td>S3@AWS Flatiron Institute FNAL</td>
<td>Turner et al, (2017)</td>
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<tr>
<td>SSC Whole Genome Data</td>
<td>~10,000 samples, 830Tb</td>
<td>S3@AWS Flatiron Institute FNAL</td>
<td>September 2017</td>
</tr>
<tr>
<td>SPARK, Whole Exome sequencing. ~1500 samples</td>
<td>~1500 samples, 21Tb</td>
<td>S3@AWS Flatiron Institute FNAL</td>
<td>Feliciano et al, (2018)</td>
</tr>
<tr>
<td>SPARK, Whole Genome sequencing. ~1600 samples</td>
<td>~1600 samples, 200Tb</td>
<td>S3@AWS Flatiron Institute FNAL</td>
<td>October 2018</td>
</tr>
<tr>
<td>SPARK Whole Exome Data</td>
<td>~27,000 samples, 200Tb</td>
<td>S3@AWS Flatiron Institute FNAL</td>
<td>October 2018</td>
</tr>
</tbody>
</table>
SFARI Data Requests

SFARI genomic data requests through SFARIBase @ sfari.org
SFARI Web Portals

• Platforms for Visualization and Integration of Genomic Data
• SFARIGene
Features:

- **SPARK Content:**
  - De novo variants
  - Rare and common transmitted variants
  - Phenotypic data

- **Integration:**
  - SSC exome and whole-genome
  - VIP

- **Query: Interface**
  - By gene
  - By set of genes (i.e. by pathway)
  - By predicted variant effect (i.e. LGDs)
  - By variant frequency
  - By transmission pattern (i.e. de novo or transmitted from mother)
  - By phenotypic properties (i.e. affected children with SCQ score larger than 20)

- **Analysis tools:**
  - Enrichment of de novo variant in a given gene set.
SFARI-IOBIO Data Federation Project

**bam.iobio:** [http://bam.iobio.io](http://bam.iobio.io)
**vcf.iobio:** [http://vcf.iobio.io](http://vcf.iobio.io)
**gene.iobio:** [http://gene.iobio.io](http://gene.iobio.io)
SFARI Gene

SFARI Gene is an evolving database for the autism research community that is centered on genes implicated in autism susceptibility.

https://gene.sfari.org
The History of Genetics of Autism through SFARI Gene

Huguet, Benabou, and Bourgeron, 2016
Lessons Learned and Recommendations

- Metadata Collection and Visualization
- Data Sharing Policy: results of the funded studies should be deposited to responsible and accessible Data Archive