



This is a peer-reviewed, post-print (final draft post-refereeing) version of the following published document, ©2022 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works. and is licensed under All Rights Reserved license:

**Bishop, Jonathan and Bechkoum, Kamal ORCID logoORCID:  
<https://orcid.org/0000-0001-5857-2763> (2023) Differences  
between neurodivergent and neurotypical learning during  
Covid-19: towards the e-Tivities Satisfaction Scale. In: 2022  
International Conference on Computational Science and  
Computational Intelligence (CSCI). IEEE, Piscataway, NJ, pp.  
2076-2080. ISBN 9798350320282**

Official URL: <http://doi.org/10.1109/CSCI58124.2022.00373>

DOI: <http://dx.doi.org/10.1109/CSCI58124.2022.00373>

EPrint URI: <https://eprints.glos.ac.uk/id/eprint/13151>

#### **Disclaimer**

The University of Gloucestershire has obtained warranties from all depositors as to their title in the material deposited and as to their right to deposit such material.

The University of Gloucestershire makes no representation or warranties of commercial utility, title, or fitness for a particular purpose or any other warranty, express or implied in respect of any material deposited.

The University of Gloucestershire makes no representation that the use of the materials will not infringe any patent, copyright, trademark or other property or proprietary rights.

The University of Gloucestershire accepts no liability for any infringement of intellectual property rights in any material deposited but will remove such material from public view pending investigation in the event of an allegation of any such infringement.

PLEASE SCROLL DOWN FOR TEXT.

# Differences between neurodivergent and neurotypical learning during Covid-19: Towards the E-tivities Satisfaction Scale

Jonathan Bishop Crocels Research CIC Crocels Community Media Group Berkeley, England <https://orcid.org/0000-0002-9919-7602>

Kamal Bechkoum School of Computing & Engineering University of Gloucestershire Cheltenham, England <https://orcid.org/0000-0001-5857-2763>

## Abstract

This paper presents the results of a study conducted during the Covid-19 pandemic into the differences between neurotypical and neurodivergent learners when it comes to participating in e-tivities. The study, conducted as part of the DWP Kickstart programme, found that neurodivergent participants are much more suited to online learning environments involving e-tivities than neurotypical ones.

## Keywords

e-tivities, Covid-19, neurodiversity, e-learning, online learning environments, DWP Kickstart

## I. INTRODUCTION

All too often, neurodiverse learners are expected to understand and function within educational environments which are set up to be understood by neurotypical learners [1]. The Covid-19 pandemic provided an opportunity for this to be reversed, with learners studying remotely being required to have a mindset not suited to the neurotypical personality.

### A. Neurodiversity in learning environments

Neurotypical learners are largely represented in research on virtual learning environments, particularly in the area of science learning [2].

### B. E-tivities

Online learning activities, or e-tivities, in their various guises, can provide for the development of socialisation, teaching, learning, and assessment of learners [3]. E-tivities are defined as “frameworks for enhancing active and participative online learning by individuals or groups” [4]. E-tivities are making a positive and successful impact to new genres for learning [5], [6]. E-tivities should be designed to engage online students in meaningful work that captures their imagination and challenges them to grow [7]. E-tivities are low-cost, reusable, customisable and scalable [4].

## II. STUDY

The study adopted a quasi-experimental approach. It used semantic differential scales based on the values set out in the ecological cognition framework for cognitions [8]-[10].

## A. Participants

Participants included those self-identifying as neurotypical (n=1) and those identifying as neurodivergent (n=2) taking part in a government funded work placement scheme during the Covid-19 pandemic via remote participation, including through the use of 'e-tivities'.

## B. Methodology

The methodology was based on an empirical design, to administer a questionnaire on a monthly basis over a six-month period to participants in the DWP Kickstart Scheme as organised by one of its 'Gateways', namely the Crocels Community Media Group. The self-identifying neurotypical participant was a woman, aged 19. The self-identifying neurodivergent participants were men, aged 22 and 23.

## C. Procedure

A 27-item questionnaire (Q) was administered to the three participants over 6 months and then an Independent Samples Mann-Whitney analysis applied with all the items suggesting the null should be accepted excluded, leaving a scale (S) of 9 items as discussed in the next section.

## D. Results

This section presents the results of the study. As can be seen from Table 1, the remaining items were highly significant, producing a reliable scale.

*Table 1 Results from the study*

S#	Q#	Statement	Mann-Whitney U	p
1	2	I felt that the content of the information provided was relevant to me	38.000	0.040
2	4	I felt I was being helpful each time I participated	45.5000	0.004
3	7	I felt I was able to trust in my own abilities	48.000	0.001
4	8	I felt I was able to help others who were stuck	48.000	0.001
5	9	I found I had access to all the information I needed	6.000	0.030
6	13	I found the content of the sessions valuable and in tune with my beliefs	47.500	0.001
7	15	I found I was able to take part in activities without feeling criticised	42.000	0.030
8	17	I felt things were tailored to my needs and I was respected as me	43.000	0.020
9	18	I felt taking part was easy without me feeling any tension	48.000	0.002

In terms of question 2, "I felt that the content of the information provided was relevant to me", as can be seen from Figure 1 the data showed that neurotypical (N=4, M=4.00) learners from the e-tivities to provide less relevant information to them than the neurodivergent (N=11, M=9.45) people did (U=38,  $p<0.041$ ). The data shows that neurodivergent participants felt far more distant from the content of the e-tivities than neurotypical learners.

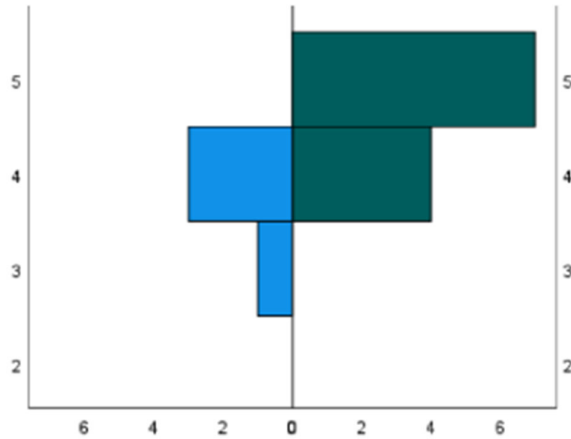


Figure 1 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 4, “I felt I was being helpful each time I participated,” as can be seen from Figure 2 the neurotypical (N=4, n=1, M=3.13) and neurodivergent (N=12, n=2, M=10.29) rated the e-tivities significantly differently for how helpful they felt they were each time they participated ( $U=45.500$ ,  $p<0.005$ ). Feeling helpful is a known motivator for sharing in some environments [11]. The data shows that neurotypical participants were much less detached when they felt they were being helpful than neurodivergent participants.

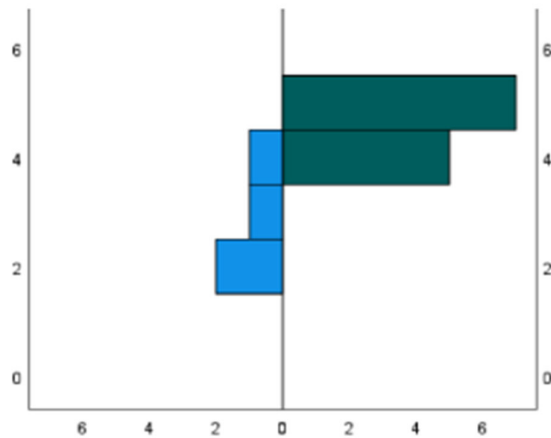


Figure 2 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 7, “I felt I was able to trust in my own abilities,” as can be seen from Figure 3, the neurotypical (N=4, n=1, M=2.50) and neurodivergent (N=12, n=2, M=10.50) participants rated the e-tivities significantly different for how they felt they were able to trust in their own abilities ( $U=48.000$ ,  $p<0.002$ ). The data shows that neurodivergent participants showed a much greater self-interest in their abilities than the neurotypical participants.

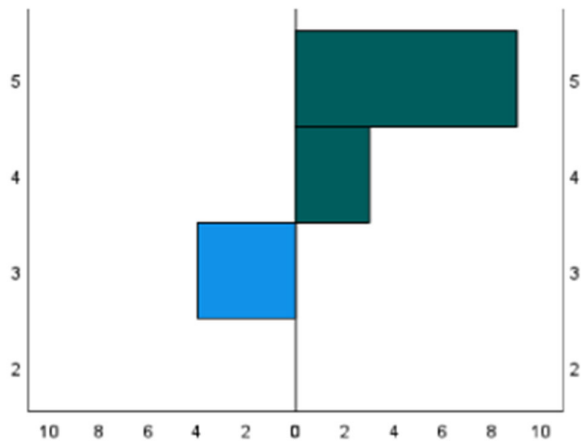


Figure 3 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 8, “I felt I was able to help others who were stuck,” as can be seen from Figure 4, the neurotypical ( $N=4$ ,  $n=1$ ,  $M=2.50$ ) and neurodivergent ( $N=12$ ,  $n=2$ ,  $M=10.50$ ) participants were significantly different in how they felt they were able to help others who were stuck ( $U=48.000$ ,  $p<0.002$ ). The data shows that neurodivergent participants have a much stronger belief in their ability to help others when stuck than neurotypical participants.

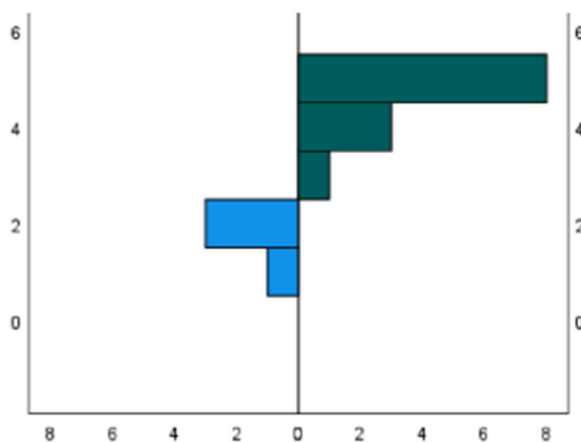


Figure 4 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 9, “I found I had access to all the information I needed,” as can be seen from Figure 5, the neurotypical ( $N=4$ ,  $n=1$ ,  $M=13.00$ ) and neurodivergent ( $N=12$ ,  $n=2$ ,  $M=7.00$ ) participants were significantly different in whether they found they had access to all the information they needed ( $U=6.000$ ,  $p<0.031$ ). The data shows that neurotypical participants feel far more detached in terms of accessing the information they needed than neurodivergent participants.

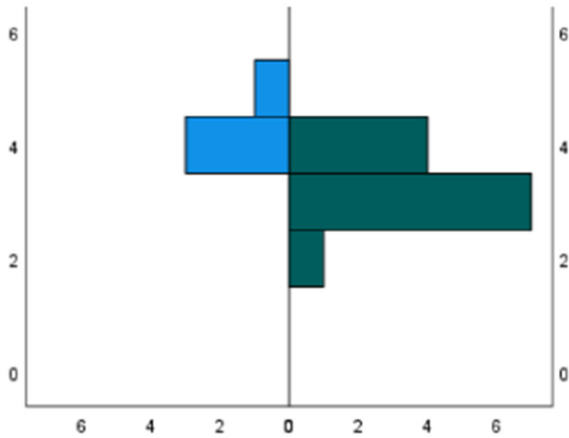


Figure 5 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 13, "I found the content of the sessions valuable and in tune with my beliefs," as can be seen from Figure 6, the neurotypical (N=4, n=1, M=2.63) and neurodivergent (N=12, n=2, M=10.46) participants were significantly different in how they found the content to be valuable and in tune with their beliefs ( $U=47.500$ ,  $p<0.002$ ). The data shows that neurodivergent learners found the sessions far more in tune with their beliefs than neurotypical learners.

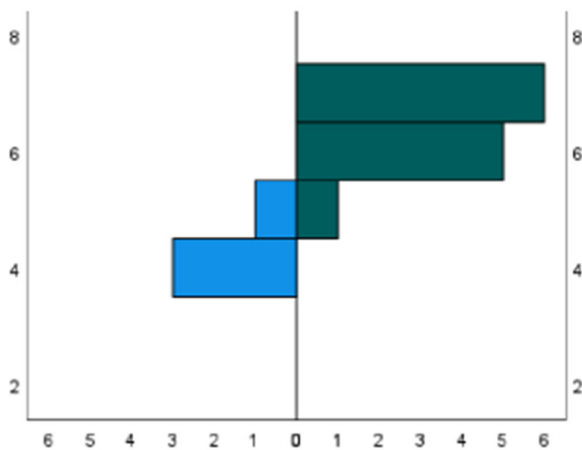


Figure 6 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 15, "I found I was able to take part in activities without feeling criticised," as can be seen from Figure 7, the neurotypical (N=4, n=1, M=4.00) and neurodivergent (N=12, n=2, M=10.00) participants were significantly different in how they found they were able to take part in the activities without feeling criticised ( $U=42.000$ ,  $p<0.031$ ). The data shows that neurodivergent participants had a slightly stronger belief in their ability to take part in activities than neurotypical participants.

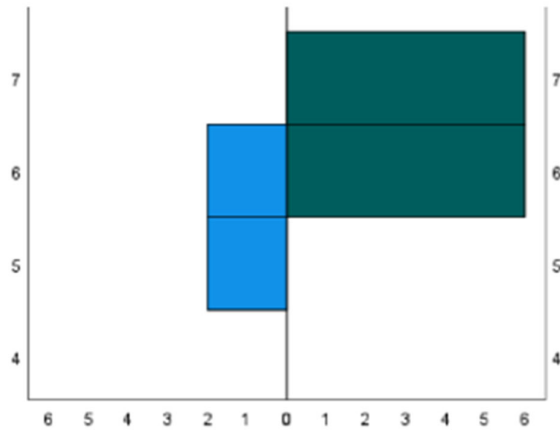


Figure 7 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 17, "I felt things were tailored to my needs and I was respected as me," as can be seen from Figure 8. the neurotypical ( $N=4$ ,  $n=1$ ,  $M=3.75$ ) and neurodivergent ( $N=12$ ,  $n=2$ ,  $M=10.08$ ) participants were significantly different in how much they felt things were tailored to their needs and respected who they were ( $U=43.00$ ,  $p<0.021$ ). The data shows that on the whole neurodivergent participants had a stronger belief in the way things were structured and respected them than neurotypical learners.

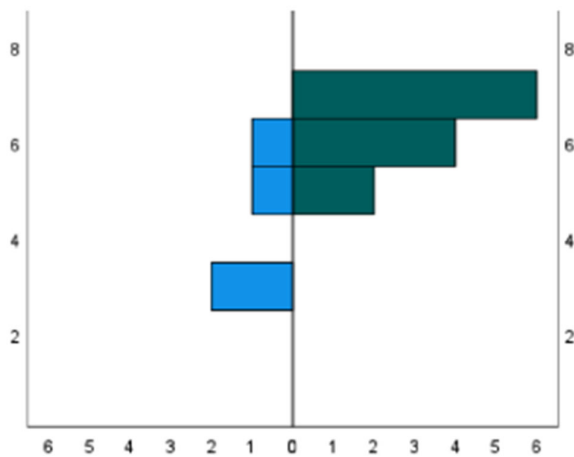


Figure 8 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

In terms of question 18, "I felt taking part was easy without me feeling any tension," as can be seen from Figure 9, the neurotypical ( $N=4$ ,  $n=1$ ,  $M=2.50$ ) and neurodivergent ( $N=14$ ,  $n=2$ ,  $M=10.50$ ) participants are significantly different in how easy they felt it was to take part without feeling any tension ( $U=48.000$ ,  $p<0.002$ ). The data shows that neurodivergent participants had a stronger belief in the ease of taking part than neurotypical participants.

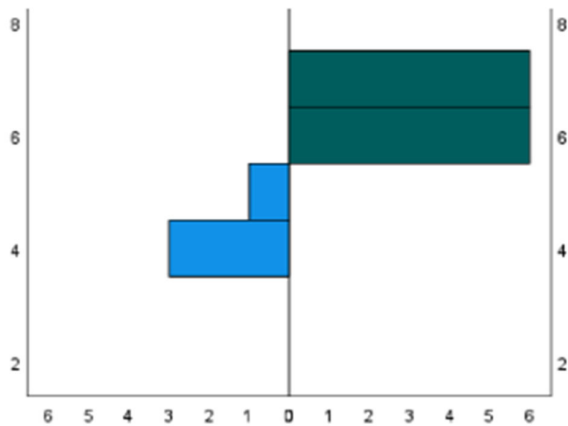


Figure 9 Mann-Whitney frequencies for neurotypical (left), neurodivergent (right)

### III. DISCUSSION

This study has investigated that participation of neurodivergent and neurotypical learners in e-tivities during the Covid-19 pandemic as part of a UK Government funded youth employment and training scheme. It found, overall, that neurotypical learners are far less enthusiastic about learning environments based around e-tivities than neurodivergent learners. It has presented an e-tivities satisfaction scale for determining the extent to which neurodiverse individuals appreciate a learning environment. Future research could investigate the scale with different 'Neuro Tribes' beyond the two basic ones investigated in this study.

### IV. REFERENCES

- [1] J. Lawson, "An investigation into behaviours which challenge at university: The impact of neurotypical expectations on autistic students," *Good Autism Practice (GAP)*, vol. 11, (1), pp. 45-51, 2010.
- [2] R. Hite et al, "Describing the Experiences of Students with ADHD Learning Science Content with Emerging Technologies," *Journal of Science Education for Students with Disabilities*, vol. 24, (1), pp. 12, 2020.
- [3] A. Armellini, S. Jones and G. Salmon, "Developing assessment for learning through e-tivities," 2007.
- [4] A. Armellini and O. Aiyegbayo, "Learning design and assessment with e-tivities," *British Journal of Educational Technology*, vol. 41, (6), pp. 922-935, 2010.
- [5] G. Salmon, *E-Tivities: The Key to Active Online Learning*. London, GB: Routledge-Falmer, 2003.
- [6] G. Salmon, *E-Tivities: The Key to Active Online Learning*. (2nd ed.) London, GB: Routledge, 2013.
- [7] B. Muirhead, "E-tivities: The key to active online learning," *Educational Technology & Society*, vol. 5, (4), pp. 179-181, 2002.
- [8] J. Bishop, "Increasing participation in online communities: A framework for human-computer interaction," *Comput. Hum. Behav.*, vol. 23, (4), pp. 1881-1893, 2007.
- [9] J. Bishop, "Enhancing the understanding of genres of web-based communities: the role of the ecological cognition framework," *International Journal of Web Based Communities*, vol. 5, (1), pp. 4-17, 2009.
- [10] J. Bishop, "Increasing participation in large-scale virtual environments: Rethinking the ecological cognition frameworks for the augmented, mixed, and virtual reality," in *Multimedia and Sensory Input for Augmented, Mixed, and Virtual Reality*, A. K. Tyagi, Ed. 2021, .



[11] N. L. Johnson, S. F. Scott and M. Brann, "'Our Birth Experiences are What Binds Us': Women's Motivations for Storytelling about Birth to Build Motherwisdom," *Communication Studies*, vol. 71, (4), pp. 649- 668, 2020.