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ABOUT

The Compass is an online scholarly journal edited and produced by students in the Arcadia University Honors Program. It is dedicated to providing a platform for undergraduate research and insight so that it may inspire, intrigue, and inform an audience. The journal's primary aim is to cultivate scholarly community and intellectual curiosity by featuring multidisciplinary perspectives, accepting articles from subjects including, but not limited to: Anthropology, Art, Biology, Business, Chemistry, Communications, Education, English, Modern Languages, Gender Studies, Sciences, Sociology, International Studies, Law, Mathematics, Philosophy, Psychology, and Religious Studies. *The Compass* endeavors to build an intellectual collaborative community that promotes the circulation of research and ideas.

FORWARD

Arcadia University is an institution dedicated to providing a distinctively global, integrative, and personal learning experience for intellectually curious students in preparation for a life of scholarship, service, and professional contribution. This issue of the student publication *The Compass* exemplifies Arcadia's mission. *The Compass* is unique among university publications in that it contains articles written by student authors, which are then selected and edited by student editors. This process not only provides valuable experience to all involved, but also fosters a community of scholarship and collaboration that is increasingly vital to the improvement of our changing global landscape.

While many of us are still spending most of our time at home during the pandemic, as you read this issue you will be brought on an intellectual journey that explores wide-ranging subjects such as the development of artificially intelligent machines through computational cognition and human rights in India. The quality of work in each submission is a testament to thoughtfulness, intelligence, and curiosity that Arcadia University hopes to inspire in all of our students.

Arcadia University is extremely proud of *The Compass* and the exceptional work produced by our student editors and writers.

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Computational Cognition and Deep Learning

By: Andy Malinsky, *Arcadia University*

Introduction

One of the goals of both neuroscience and artificial intelligence (AI) is to understand the composition of intelligent cognition, otherwise simply referred to as intelligence. As commonly defined for empirical neuroscience research, intelligence is a general mental ability.[1] It consists of being able to learn new things quickly through logic and abstract reasoning, allowing us to understand an environment and solve problems. In order to make informed decisions and actions, the intelligent system must process some input from which to learn and make inferences. This is the main idea and inspiration behind deep learning, a subset of algorithms within AI. Decisions regarding surrounding environments are made based on inputs received from the senses (mainly sight, touch, and sound). Analogically, connections can be made between these inputs and areas of deep learning, such as vision to sight, reinforcement learning to touch, and natural language processing to sound.

How the brain works is still highly regarded as one of the biggest fundamental mysteries of our universe. Current understanding is challenged by the underlying principles behind the brain's processing of sensory input information up to thoughts and then up to actions. "Intelligence" can be viewed as human-level reasoning from these principles. Both cognitive neuroscientists and AI researchers seek to solve the problem of intelligence: "How can a system composed of relatively unintelligent parts (say, neurons or transistors) behave intelligently?"[2] A major component of this problem involves the process of learning.

To understand what we know so far about learning in the brain, it is important to have a general understanding of what neurons are and how they operate. The region of the brain where most of our cognitive thought takes place is the neocortex, which houses around 20 billion neurons.[3] Each neuron is interconnected with roughly 10,000 others. Communication between neurons happens through synapses, or connection points, by means of electrical signals. Incoming signals carry synaptic weights, which determine whether or not the receiving neuron will activate and send an output signal. Our fundamental understanding of how learning works in the brain is based on the local neural activity patterns between sending and receiving neurons. This activity results in changes in the connections between neurons, a process known as synaptic plasticity. Everything that we learn is essentially different patterns of synaptic weights.

Updating synaptic weights is the key inspiration for deep learning, a subset of machine learning algorithms within the field of AI. It mainly involves the use of more biologically inspired methods, as opposed to traditional machine learning approaches. These methods consist of architectures known as artificial neural networks. Artificial neural networks were designed to operate or "learn" similarly to the biological neural networks found in the brain by continuously updating connections between neuron units. Industry breakthroughs ranging from self-driving cars, self-play game mastering, image classification, and language translation demonstrate deep learning's powerful potential. Deep learning tools can also be beneficial to neuroscientists as they employ cognitive modeling to test their theories of how the brain performs certain tasks and computations. Essentially, we can attempt to use artificial neural networks to mimic the neuronal activity we see in biological systems, which also allows us to bypass ethical concerns over tweaking a human brain to identify contributing factors toward accomplishing a task.[4]

An artificial neural network is said to be "deep" if it consists of multiple layers. A typical model has an input layer, many hidden layers, and an output layer. Each layer is made up of "neurons," or nodes, and each node in a given layer is connected to each node in an adjacent layer with a given weight. These weights can

1 Richard J. Haier, *The Neuroscience of Intelligence* (Cambridge University Press, 2016), 4-5.

2 N.L. Cassimatis, "Artificial intelligence and cognitive modeling have the same problem," *in Theoretical Foundations of Artificial General Intelligence* (Paris: Atlantis Press, 2012), 11-24.

3 R.C. O'Reilly et al., *Computational Cognitive Neuroscience,* 1st ed (Wiki Book, 2012, 3), 12-13.

4 Neil Savage, "How AI and neuroscience drive each other forwards," *Nature* 571 (2019), 10.1038/d41586-019-02212-4.

then be adjusted based on a variation of the stochastic gradient descent model in order to minimize error in generated output values. Neuron activations are forward-and-back propagated through the layers of the network, and the weights are updated accordingly. The process of learning in this system is known as "backpropagation." After the network goes through this training process, it should be able to take new input and provide expected output with an ideally high accuracy. This is the fundamental way deep neural networks function, and Figure 1 provides a visual representation of the underlying mathematics involved.

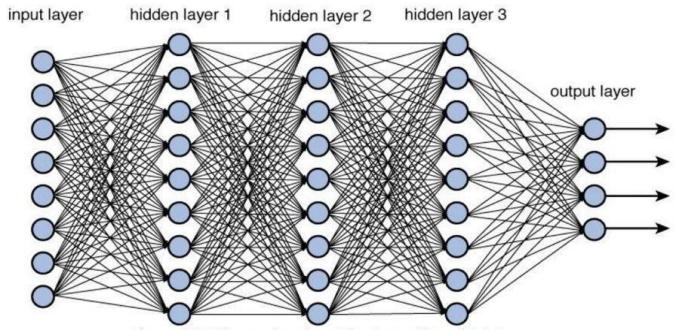


Figure 1: This is a common graphical representation of a deep neural network model.[5]

Neural networks and the backpropagation algorithm were originally designed from the simplest understanding of changes in synaptic weights between neurons. However, many AI researchers have contended that the human brain does not exactly learn the way standard deep learning demonstrates. This concern is about the theme of biological plausibility, the notion that algorithms more closely resembling the processes found in the human brain would improve performance. For example, spiking neural networks[6] have been proven to show promise in this direction. They consist of neuron units that relay information via spikes, or time-based signals, and model simplified versions of biological neuron thresholds and network dynamics. They have also been shown to perform unsupervised learning successfully, using spike-timing-dependent plasticity,[7] a highly biologically plausible approach not commonly utilized in practical applications. A path toward more unsupervised approaches seems to be in order, as humans are capable of learning without a "teacher" when it comes to general problem-solving and critical thinking, while the standard backpropagation model detailed above still requires a "teacher" to feed it labelled data.

Further integration of neuroscience with deep learning may have the potential to solve the biggest challenge in AI: artificial general intelligence, or AGI. The goal of AGI is to create software or hardware systems with general intelligence comparable to or greater than that of a human.[8] AI company DeepMind developed an algorithm involving neural networks called AlphaZero that was able to master the 2,000-year-old game of Go in the space of a few days.[9] Computer programs have the ability to perform amounts of computations that would take humans hundreds or even thousands of years. The end goal is to apply this same level of computational analysis to optimize problems or find solutions in various domains such as healthcare, the environment, finance, and society resource management. AI could uncover patterns in overwhelmingly complex datasets and suggest promising ideas and strategies.[10] To move the field forward, a unifying theory of intelligence would be most ideal, as it would apply to both neuroscience and AI research.

This paper will discuss three active areas of research pertaining to both cognitive neuroscientists and deep learning researchers, including vision, reinforcement learning, and natural language processing. Each of these areas requires some form of human-level reasoning, which allows for specific avenues of investigation in intelligence research. Introduced in the fol-

5 Ravindra Parmar, "Training Deep Neural Networks," *Towards Data Science*, September 11, 2018, https://towardsdatascience.com/training-deep-neural-networks-9fdb1964b964.

6 Guy Dove, "On the need for embodied and dis-embodied cognition," *Frontiers in Psychology* vol. 1 (2011): 242.

7 Peter U. Diehl and Matthew Cook, "Unsupervised learning of digit recognition using spike-timing-dependent plasticity," *Frontiers in Computational Neuroscience* vol. 9 (2015): 99, https://doi.org/10.3389/fncom2015.0099

8 B. Goertzel, "Artificial general intelligence: concept, state of the art, and future prospects," *Journal of Artificial General Intelligence* 5, no. 1 (2014): 1-48, https://doi.org/10.2478/jagi-2014-0001.

9 D. Silver et al., "Mastering chess and shogi by self- play with a general reinforcement learning algorithm." arXiv (2017). https://arxiv.org/abs/1712.01815.

10 "AI and the world's complex challenges," DeepMind Technologies Limited, 2019, https://deepmind.com/applied/deepmind-ethics- society/research/AI-worlds-complex-challenges/.

lowing sections for each research area are the aspects of human cognition involved, along with examples and limitations of the artificial counterparts realized by deep learning.

Vision

Vision plays a crucial part in how the world is perceived and understood. According to Jamie Ward, an acclaimed professor of neuroscience, vision is when "the brain divides a continuous pattern of light into discrete objects and surfaces to translate the two-dimensional retinal image into a three-dimensional interactive model of the environment."[11] The main visual pathway in the brain is known as the primary visual cortex. Neurons in this brain region encode sensory input in terms of edges, or transitions of illumination, to begin developing a mental representation of the perceived natural physical image.[12] This cognitive process involves three stages: perception, recognition, and action.[13] Perception is the sensory experience obtained from consciously translating an input image into a form of acknowledgement signaling that an object has been perceived. Recognition is the brain's way of categorically identifying what it sees. These categories may be developed through prior knowledge or experiences as they help shape individual understanding. Then, action takes place in terms of activity in our motor systems. Depending on the stimulus being perceived, a resultant behavior is expected. For example, if one perceives and recognizes a ball coming towards them, they may take action by putting their hands up to catch it. The cognitive process of vision continuously runs during average daily activity and contributes to how the brain learns new information by constantly providing inputs from its surroundings. The way the human brain is able to interpret and understand what it sees demonstrates a level of intelligent comprehension that is still not fully understood. The eye to brain process, however, still serves as an inspiration for the common way AI "sees."

Common cognitive models used for object recognition tasks are known as convolutional neural networks. Inspired by the biological eye, the neural net scans the input image pixel by pixel, extracting features of the given objects. For example, if the task is to distinguish between a cat and a dog, it can look for features such as "floppy" or "pointy" ears, "dog snout," or "fur."[14] Alternative techniques such as feature visualization allow for a semantic dictionary of how the network understands the input image as a whole. The network would need to go through a training process first in order to identify each feature representation.

Figure 2

Figure 3

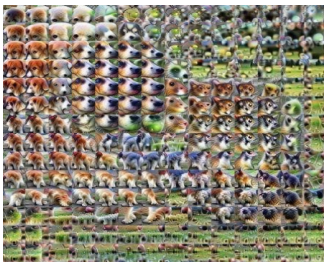


Figure 2 depicts a standard input image of two dominant objects, each with representative features. Figure 3 depicts the resulting feature visualization map, or a semantic dictionary of detected features from the input image.[15] In order for a computer to understand the difference between two given objects, this approach utilizes the idea that the biological brain stores memory of specific sets of features that help to identify similar objects in the future. By way of extracting and identifying features, we are attempting to mimic computationally how the human brain would understand a given visual input.

Convolutional neural networks have a great impact in emerging technologies like self-driving cars and facial recognition, but deep learning for computer vision still has limitations. Training neural networks requires a large amount of labelled data. A network has to learn what "floppy ears" are before it can recognize them in an image. Bias in the lack of realistic examples, such as varying viewpoints, results in worse scene understanding and lower accuracies for object recognition. If the majority of training examples are similar to a particular angle, the network may have a harder time recognizing an object in a new image that is from a completely different viewpoint.[16] For instance, the human brain can understand that a dog

11 Jamie Ward, *The Student's Guide to Cognitive Neuroscience*, 3rd ed. (London: Psychology Press, 2015), 107.
12 R.C. O'Reilly et al., *Computational Cognitive Neuroscience*, 1st ed. (Wiki Book, 2012), 76.
13 Bruce E. Goldstein, *Sensation and Perception*, 8th ed. (Boston, MA: Cengage Learning, 2010), 8-9.
14 C. Olah et al., "The building blocks of interpretability," *Distill 3* (2018) no. 10. https://doi.org/10.23915/distill.00010.
15 Ibid.
16 A.L. Yuille and C. Liu, "Deep Nets: What have they ever done for Vision?" *arXiv* (2018): 3.

is still a dog whether looking from in front or behind. The development of better methods for overall scene understanding and general contextualization is a current challenge. A self-driving car would become safer if it understood its surroundings rather than simply observing and reacting to them. Therefore, current models of computer vision still have room for improvement.

Reinforcement Learning

Responses from external stimuli affect human behavior. The brain region responsible for learning from reward and punishment signals is known as the basal ganglia.[17] This specialized area directly influences the actions humans take, which results in a form of learning called reinforcement learning. Dopamine neurons activate when a reward is delivered, conditioning the brain to expect a reward upon taking a given action.

This topic of conditioning is one that arises under procedural learning through associations.[18] This type of learning deals with procedural memories, in that a given sensory input generates a given motor or sensory output. These reactions can be learned, or conditioned, along reflex pathways in the brain. Classical conditioning is a type of associative learning that involves learning an association from two different stimuli to the same individual response.[19] As seen in the famous experiment from Russian physiologist Ivan Pavlov, depicted by Figure 4, dogs were conditioned to salivate upon hearing a certain sound. The figure below illustrates the conditioning process.

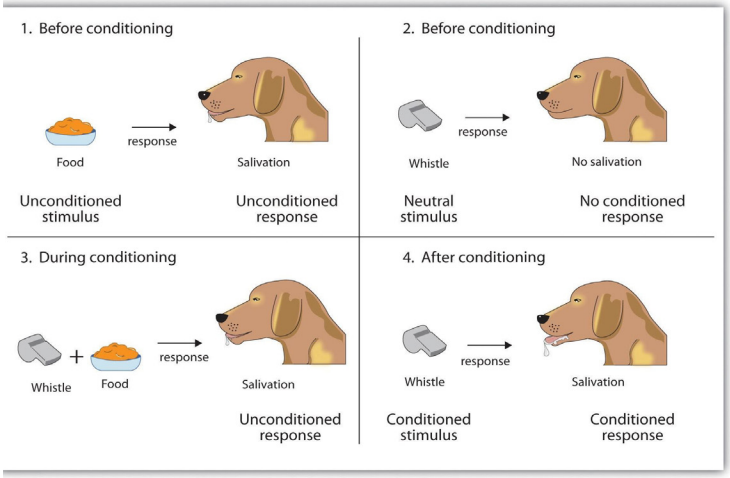


Figure 4: An example of classical conditioning.[20]

The dog in the experiment learns a new association between the presence of the food and an auditory stimulus. This reaction is essentially a form of reinforcement learning: the dog will predict food to arrive upon hearing the same sound, thus resulting in the expected response. Conditioning and reinforcement learning processes are evolutionarily beneficial[21] because they allow for the development of new associations between particular stimuli and good or bad events. Humans are constantly making decisions based on associations created to benefit survival. Learning through trial and error is one of the main methods of learning about the world from a young age. This type of trial-and-error cognitive reinforcement learning provides the inspiration for cutting-edge computational models employed for deep learning. DeepMind's program AlphaZero learned to master the game of chess through the process of reinforcement learning. Using a deep neural network architecture of many layers, it learns by self-play. Based on results from wins, losses, and draws, it adjusts the network's parameters to make it more likely to choose better moves in the future.[22]

However, AlphaZero is unique because it is general-purpose. It is able to learn any two-player perfect information game given just the set rules to follow. This is a big step forward in AGI, but a potential route for further research would be to implement transfer learning. For example, a person who knows how to

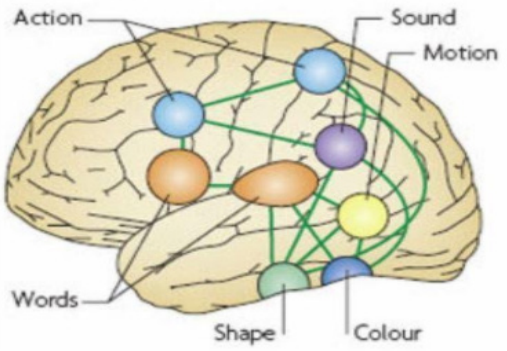
17 R.C. O'Reilly et al., *Computational Cognitive Neuroscience*, 1st ed. (Wiki Book, 2012), 78.
18 Mark F. Bear et al., *Neuroscience: exploring the brain* 4th ed., (Philadelphia: Wolters Kluwer, 2016, 827).
19 Ibid; Charles Stagnor, "Learning by Association: Classical Conditioning" in *Introduction to Psychology* 1st ed. (Boston, MA: Flatword, 2018), https://open.lib.umn.edu/intropsyc/chapter/7-1-learning-by-association-classical-conditioning/.
20 Stagnor, *Introduction to Psychology.*
21 Ibid.
22 Silver et al, "Mastering chess and shogi by self- play with a general reinforcement learning algorithm."

play the guitar may be able to pick up the piano faster than someone with no musical background.[23] Learning from reinforcement and then transferring gained knowledge to new tasks is a skill in which the human brain excels, so perhaps AI research could benefit from further inspiration from neuroscience. Reinforcement learning methods need to be more generalized, which would benefit robotics as well. Autonomous agents would have a better understanding of their environment and would be able to make even better decisions about which actions to take. Logical decision making is the fundamental goal of artificial general intelligence, so further research into reinforcement learning would help in this endeavor.

Natural Language Processing

In addition to translating knowledge to a variety of skills, the human brain also excels in processing one of the most complex forms of communication: language. People understand each other based on individual systems of semantic representations, or relationships between words and symbols to their meaning in reality. This ability to understand complex connections is the idea behind a dominant notion of amodal, or abstract memory.[24] Figure 5 depicts this cognitive process displayed in the hub-and-spoke model.

Figure 5: The hub-and-spoke model is a hybrid model of semantic memory, containing both amodal and grounded representations



in sensory and motor systems.[25] Processes similar to that of mental imagery take place, which can make sense intuitively. People essentially translate generated mental images and associations into representative words. These words are ingrained through a training or learning process, as people develop those connections, or associations.

For example, consider the word "elephant" and one may recall associated properties such as long trunk, animal, big ears, or gray skin. Because of these varied associations, a linguistic symbol grounding problem arises in that there must be a way to define words without the use of other words.

The idea of embodied cognition offers grounded associations, a solution to the symbol grounding problem. Theories of embodied cognition suggest that "neural systems involved in understanding real objects, actions, and events in the world are used to internally simulate those objects, actions, and events at later points in time."[26] As such, words or concepts can additionally be associated with simulations of sensorimotor activity. For example, the concept of "greeting a person" may be associated with the motor activity of shaking a hand. This additional sensorimotor simulation adds to the brain's understanding of a given concept. Also, it has been shown that perceptual representations can substantially increase the computational power of artificial intelligence systems.[27] Current language modelling networks in the industry may take slightly different approaches.

Similar to computer vision tasks, language reading may also take the form of object recognition. Brains go through a form of a training process when first learning how to read. Connections are made between visually interpreted symbols to their corresponding sound and ultimately to their corresponding objective meaning. Studying this phenomenon gives us insight into how the brain processes visual symbolic representations of words and ideas.

Computational algorithms that automatically analyze and represent human language fall under the category of Natural Language Processing (NLP).

23 K. Weiss, T. Khoshgoftaar, and D. Wang, "A survey of Transfer Learning." *Journal of Big Data* (2016), https://doi.org/10.1186/s40537-016-0043-6.

24 Jamie Ward, *The Student's Guide to Cognitive Neuroscience,* 3rd ed. (London: Psychology Press, 2015), 31.

25 Ibid.; Greg Hickok, Adapted from Patterson et al., 2007. "Semantics and Brain," *Talking Brains,* January 15, 2008, http://www.talkingbrains.org/2008/01/semantics-and- brain-more-on-atl-as-hub.html.

26 Guy Dove, "On the need for embodied and dis-embodied cognition," *Frontiers in Psychology* 1, (2011): 242.

27 J.I.Glasgow, "The Imagery Debate Revisted: A Computational Perspective," *Computational Intelligence* 9 (1993): 310-333, doi:10.1111/j.1467-8640.1993.tb00224.x.

One deep learning approach to NLP is the use of recurrent neural networks. This type of model uses a computational structure known as "Long Short-Term Memory" which is able to process through sequences of data with a temporal internal state memory.[28] An example that utilizes this technology is Google Translate.[29] Google Translate demonstrates Neural Machine Translation, in which it encodes the source language and decodes to the target language. It uses sequence to sequence modeling to summarize the source sentence in the translated version. Language modeling has seen great breakthroughs such as Google Translate, but there are still limitations. Semantic understanding is the direction for further research. Exactly how people acquire languages and develop higher-level semantic representations may provide insights into ways to improve state-of-the-art natural language processing applications.

Conclusion

The current technological revolution is rapidly developing. Computational cognitive neuroscience has set the foundation for deep learning, seen in the power of artificial neural networks. Inspired by areas of human cognition, including vision, reinforcement learning, and natural language processing, computational models have been developed in an effort to mimic the complexity of the human brain. However, there is still room for improvement as the function of intelligence has yet to be fully solved. Many say that AGI is a long way away, but with a stronger coordinated effort between neuroscientists and deep learning researchers, general intelligence could be fully understood sooner rather than later.

28 S. Hochreiter and J. Schmidhuber, "Long short-term memory," *Neural Computation* 9, no. 8 (November 1997): 1735-1780, https://doi.org/10.1162/neco.1997.9.8.1735.

29 Yonghui Wu et al., "Google's neural machine translation system: Bridging the gap between human and machine translation." arXiv (2016), https://arxiv.org/abs/1609.08144.

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From Japanese to Elvish: Comparing Different Writing Systems

By: Isabella Bumbera, ***Arcadia University***

Abstract

In terms of literacy, the combination of orthography – the conventional spelling system of a language – and second language (L2) acquisition is not widely studied. The research thus far comprises auditory or verbal acquisition - showing that an L2 learner studying a language phonetically similar to their own would have greater ease in acquiring the L2.[1] While similar phonetics play a part in ease of L2 acquisition, the research focuses mainly on grammar and debates providing corrective input versus no input when learners make a grammatical error. Although many studies demonstrate how phonetics and grammar contribute to L2 learning, they neglect to examine how a language's orthography affects L2 reading comprehension. Due to these limits, the present study aims to determine how L2 learners comprehend sentences when provided a language with a writing system different from their own.

Literary Analysis

Contrastive Analysis

The theory of contrastive analysis states that languages are less challenging to learn because of either grammatical or phonetic similarities between them. In Kortmann's 1996 study of this theory, the focus is primarily on Latin, providing the basis for grammatical and linguistic systems of most modern languages. Since Latin stands as the standard, there are structural similarities between many different languages. This theory is an area of comparative linguistics concerned with the comparison of two or more languages. This also brings attention to the idea that having fluency or proficiency in multiple languages causes conflict in the mind of the L2 learner.[2] Comprehension of two or more languages was later proven to have little impact on the further teaching of languages in schools. Learners who were already proficient in multiple languages did not face the aforementioned difficulties in learning additional languages. However, the contrastive analysis did serve to demonstrate "error analysis," which is when L2 learners understand the mistakes they are making when practicing their L2. However, the theory does not reveal where these learning difficulties stem from.[3]

Kortmann's study also focuses on the comparison of typography, structural differences, and similarities between languages that lend to the development of all writing systems. Ultimately, there is a conventional design between different writing systems. This becomes relevant when comparing different languages because the strict script of a language, without knowledge of how different characters sound, alters how the language learner remembers the written language.[4]

Contrastive analysis also calls into question a "parallel corpus," an anthology of written work in its original language and its subsequent translation into the target language.[5] Comparison of grammar is thus allowed across different written languages and reveals the similarities and differences between one's first language (L1) and their second. L2 learners often start by reading texts specifically written for language-learners, using basic phrases and tenses because they aid the learner in gaining literate comprehension in their target language. In classroom settings, this study is particularly relevant and focuses on teaching students using these translated works, before correcting their grammar based on discussions surrounding these works.

However, contrastive analysis is not always predictive of L1 to L2 comprehension and acquisi-

1 Bernd Kortmann, *Adverbial Subordination: A Typology and History of Adverbial Subordinators Based on European Languages* (Berlin: Walter de Gruyter & Co, 1996); Stefan Gries, "What is Corpus Linguistics?" *Language and Linguistics Compass 3*, no. 5 (September 2009): 1225-1241, https://doi.org/10.1111/j.1749-818X.2009.00149.x; Akbar Azizifar, "The Effect of Grammatical Consciousness Raising Task on Iranian EFL Learners' Reading Comprehension," *Procedia - Social and Behavioral Sciences* 192, (June 2015): 252-259, https://doi.org/10.1016/j.sbspro.2015.06.036.; Esther Geva. "Learning to Read in a Second Language: Research, Implications, and Recommendations for Services." (2006).

2 S.P. Corder, "The significance of learner's errors," IRAL: *International Review of Applied Linguistics in Language Teaching* 5, no. 4 (1967): 161-170, https://psycnet.apa.org/doi/10.1515/iral.1967.5.1-4.161.

3 Kortmann, 1996.

4 Gries, 1225-1241.

5 Ibid.

tion.[6] It is also noted that even if there are grammatical patterns present in a learner's L1 that also appear in their L2, it is common for the learner to misuse those grammatical concepts when learning the L2. Not only this, but difficulties in comprehending an L2 also occur regardless of the learner's L1. Essentially, the similarity between a person's L1 and L2 does not affect how difficult it is to learn the second language.

This present study focuses primarily on grammatical differences between languages, instead of the actual writing systems. Specifically, it looks at the individual characters used in the different writing systems. Pertaining to the Romance languages that use the same Latin writing system, the grammatical structure of sentences is the primary focus of study. However, these particular languages all use the same or similar systems of orthography. There are no current studies that specifically focus on reading comprehension between L2 learners who are studying languages with different writing systems from their own.

The Effect of Grammatical Consciousness on Reading Comprehension

Azizifar[7] researches the impact of the Grammatical Consciousness Raising task when studying English as an L2 by observing 14 to 15-year-old Iranian women learning English in high school. This study focuses primarily on reading comprehension of the English language as an L2 from learners whose L1 is Farsi (or Persian, as it is known to the Western world.) In this study, they use Consciousness Raising (CR) in which tasks designed by Svalberg are used to raise the learner's Language Awareness (LA). Fundamentally, the learners are focusing on aspects of their L2 that also exist in their L1, whether they are aware or not. The learners in this particular study were asked to draw conclusions based on the texts that they read in their L2.

Azizifar also focuses on creating consciousness, or awareness, of reading comprehension for the learners as they read in their L2 by using the Grammatical Consciousness Raising Task.[8] Such tasks allow learners to analyze the differences between their L1 and L2, possibly through the use of a basic grammar exercise, and then allows learners to discuss their findings with their peers. Consciousness Raising (CR) then enables the learners to discuss what they have learned while focusing on the grammar of the text. This discussion allows them to achieve a better social and cultural understanding of the text, as well as a better grasp of how the L2 works. CR, as described in this study, may often be the primary approach used by many teachers when teaching an L2. The L2 learners can draw connections between their L2 and their L1, while also intentionally noting the differences between the two languages. After discussing the connections between the languages and their attention to grammar, the learners pay more attention to their language output.[9]

In contrast to other studies, Azizifar's study includes a post-reading conversation about the text. Given different aptitudes of language acquisition between each learner, the post-reading conversation will most likely heighten the understanding that each learner has of the text, even among differences in language learning aptitude. Regardless of their initial comprehension, conversing with others will give them different perspectives on what they have learned. This conversation, subsequently, will encourage all learners to think more critically about their L2.

Learning to Read in a Second Language (L2)

When teaching L2 learners to read, specifically children,[10] two principal ideas are relevant to comprehension: central processing and typological differences between the learners' L1 and L2. The central processing framework[11] states that if the comprehension of information a student has in their L1 is similar to comprehension of information in their L2, then how the learner processes this information should be similar. For example, L2 learners who have acquired literacy in their L1 should have some degree of transfer of skills when they are attempting to gain literacy in their L2. On a biological level, information processing of the written word occurs in the same area of the brain, therefore allowing some potential overlap in how the learner interprets their L2. However, it is essential to note that this is not true of all languages. Despite this shared information processing center, an overlap is

6 Lourdes Ortega, *Understanding Second Language Acquisition* (London: Hodder Education, 2009).
7 Azizifar, 252-259.
8 Ibid., 252-259.
9 Ibid., 252-259.
10 Geva, 2-6.
11 Ibid.

not guaranteed. This is because L2 learning difficulties can occur in many instances, regardless of the learner's L1.[12]

The typological framework's relevance to this orthographic study states that different languages have different orthographic depths. For instance, English is deeper orthographically than languages such as Spanish or German[13] because of the spoken, audible phonetics and how they relate to each written syllable. By studying the typographical differences between different languages, it becomes possible to determine how L2 learners are processing the script. There are different processing paths for different writing systems. For instance, alphabetical systems like the Romance languages are comprehended differently from those of character-based writing systems such as Chinese or Japanese. These differences have led to the reasoning that if a child L2 learner's L1 is alphabetic and their L2 has a character-based writing system (or vice versa), then the learner will have difficulties in processing and interpreting the written L2 due to less overlap in the brain's processing of the text.

These difficulties have led to conclusions about the occurrences of reading disabilities, such as dyslexia, because of the varying difficulties in the writing systems of different languages.[14] Geva's study, one of the most recent, focuses on orthographic linguistics and SLA. However, Geva's primary focus is on pre-pubescent L2 learners; therefore, it is less relevant for the present study in which we investigate post-pubescent L2 learners. Adults have a more extensive range of outside knowledge, as well as more developed brains than children. For the present study, monolingual college students whose L1 is English, ranging from ages 18-21, will be studied to determine if the languages Japanese, Hindi, Elvish (from J.R.R. Tolkien's The Hobbit and The Lord of the Rings series), Korean, Russian, and Chinese have writing systems that are easier or harder to understand given the student's lack of prior experience studying the languages.

The specific orthographies for each of these languages, although most of them are of Asian origin, include a unique design and set of characters. Japanese includes three written languages- Kanji, Hiragana, and Katakana. Kanji uses symbols which derive from Chinese, while Hiragana and Katakana use symbols which indicate syllable sounds within a word.[15] This study focused on Hiragana. Hindi uses the Devanagari script, which has 11 vowels and 35 consonants.[16] Elvish, or Quenya, is an unofficial language created by author J.R.R. Tolkien. It contains many accent marks and emphasis on harsh vowels within its script.[17] Korean, like Kanji, also derives from Chinese using an alphabet called "Josoen guele" and the written syllables are blocks.[18] Russian contains 33 letters- 11 vowels, 21 consonants, and two signs; ь, ъ.[19] Chinese uses characters which correspond to individual phonetic sounds.[20] All of the orthographies in this study differ from the Latin alphabet and from each other. The following research questions explore these differences.

Research Questions

In order to determine the varying levels of difficulty in learning languages that were not constructed based on the Latin alphabet, L2 learners that had only language learning experience with Romance languages participated in this study. The following questions were asked during this study:

I. Is any language's writing system easier to comprehend for L1 English speakers given no previous experience studying the L2s presented?
II. Are there any distinct similarities or transfer of knowledge between the L1 English alphabet and any of the L2s presented?
III. Did the participants' methods for studying the written languages impact how much they absorbed?

L1 English speakers were asked to study a

12 Ortega, 82-84.
13 Geva, 2-6.
14 Ibid.
15 Shoko Mugikura, "Japanese Writing, A Beautifully Complex System," Smashing Magazine, March 6, 2012, https://www.smashingmagazine.com/2012/03/japanese-a-beautifully-complex-writing-system/.
16 "A Guide to Hindi - The Hindi alphabet," BBC online, http://www.bbc.co.uk/languages/other/hindi/guide/alphabet.shtm.
17 "How to Speak Elvish," WikiHow, December 7, 2016, https://www.wikihow.com/Speak-Elvish.
18 Simon Ager, "Korean alphabet, pronunciation and language," https://www.omniglot.com/writing/korean.html.
19 Julia Rochtchina, "Russian Alphabet." Russian Alphabet with Sound and Handwriting, http://www.russianforeveryone.com/RufeA/Lessons/Introduction/Alphabet/Alphabet.htm.
20 Ager.

Quizlet set and then take a multiple-choice test based on the information they had just learned. The results of the multiple-choice tests were recorded for accuracy. The results of the tests measure how much the participants had retained and were then able to regurgitate.

Methodology

Participants

Seven students were asked to participate in this study. All of them were English L1 speakers studying at Arcadia University, with ages ranging from 19-21 years. They all had previous experience studying Romance languages throughout their primary and secondary education. There were three male and four female students; their respective areas of study were Criminal Justice, Political Science, Computer Science, Mathematics, History, Accounting and Video Communications.

Language Learning

Each participant first studied the same Quizlet set. They were given two written words to learn in each language (Japanese, Hindi, Elvish, Korean, Russian, and Chinese) but not told what the language was. First, they were shown the word for "thank you" and then each character of the word. The same process was repeated with the word for "parents." Each participant reviewed the study set at their own pace. Some rapidly clicked through the set while others carefully studied each letter. Some spoke their thoughts out loud, while others remained silent throughout their studying process.

Testing

After studying each set, each student took the same online test. The test consisted of 12 multiple choice questions, the first six asking for the correct translation of "thank you" in each language. The participants answered the same questions for the word "parents." Each question provided five possible answers with only one being correct. Table 1 highlights the percentage of correctly identified answers for each question.

Table 1

Question Number	Percentage of Participants that Answered Correctly
Question 1 (Japanese "thank you")	25%
Question 2 (Hindi "thank you")	62.5%
Question 3 (Elvish "thank you")	87.5%
Question 4 (Korean "thank you")	100%
Question 5 (Russian "thank you")	87.5
Question 6 (Chinese "thank you")	75%
Question 7 (Japanese "parents")	57.1%
Question 8 (Hindi "parents")	85.7%
Question 9 (Elvish "parents")	42.9%
Question 10 (Korean "parents")	71.4%
Question 11 (Russian "parents")	100%
Question 12 (Chinese "parents")	71.4%

Results

The study reflected the results of participants with a wide range of comprehension. However, the results strongly suggested a few consistent conclusions:

I. Russian was the easiest for the participants to comprehend, given 87.5% were able to recognize the translation for "thank you" and 100% recognized the correct translation for "parents".

II. There was a distinct transfer between the participants' L1 and L2 when prompted with Elvish. Two of the participants, who spoke out loud as they studied, noted that the Elvish word for "parents" looked similar to the word "para" from Spanish. It is also similar to the spelling of the word in English.

III. The participants' own studying methods directly altered how well they performed on the test. Those that stayed fixated on each character for extended pe-

riods performed far better than those that only rapidly clicked through the set - not focusing on the individual characters but instead rushing to read the next word.

Discussion

As previously stated, all participants were monolingual L1 English speakers, who all had previous experience studying the following languages: Spanish, Italian, German, French, Latin, and Hebrew. The results of this study suggest that the more similar the scripts appeared to their L1 English, as observed when looking at the results of the Russian questions, the easier it was for the participants to learn and then recognize when presented with a multiple-choice question.

It is also worth noting that the Korean writing of "thank you" was correctly recognized by all of the students due to the length of the word. In this way, the participants were not remembering specific characters but memorizing the length of the word and, therefore, were still able to distinguish it from the other ones provided.

This study did not take into account the levels of anxiety experienced by the learners during the study portion. However, they were all given the same information before and after the test. All participants understood they could click through the set at their own pace and, even if they did not get a perfect score, their results would not negatively impact their grade or the study. The atmosphere aimed to keep all participants comfortable and relaxed as they studied and then took the test.

Many of these participants repeated the words to themself and seemed to study the length of the words as opposed to the individual letters or characters being used. Only one participant received a perfect score on the exam, after studying by clicking back and forth between the Quizlet study set and associating different characters with different actions or people. For instance, the Korean character " " was a "desktop computer" and the Russian character "Д" was "a car driving off into the distance".

Conclusion

This study suggests that L1 monolingual English speakers have an easier time recognizing characters from the various writing systems that are most similar to their own. From this, we can then determine that there must have been some knowledge transfer, as those letters in the Russian alphabet which closely resembled those in the English alphabet were easiest for the participants to differentiate and recognize. However, the participants noticed immediately when one word was much longer than the other four options in a question, which may have led to skewed results. For instance, "thank you" in Korean was significantly longer than the other options presented; therefore, all 7 participants were able to identify it correctly.

This study was conducted on a college campus; therefore, the primary investigator brought the test to the participants. This resulted in a constant flux of environment. Some of the participants studied and took the test in a classroom. Others were able to participate from the comfort of their housing accommodation. The primary setting for this study being a small college campus also contributed to the small participant number. It is encouraged that future studies collect a greater pool of participants. There was also not a time limit for how long each participant had to study the Quizlet set. For this reason, some of them skimmed through the set in less than 5 minutes while others focused more intently on committing each one to memory for up to 10 minutes.

Ultimately, more controlled study and testing environments and more uniformity within the questions themselves would lead to a more accurate representation of how different writing systems are perceived and learned by L1 English monolingual speakers. L2 learners are also more inclined to notice and focus on the similarities between their own L1's writing system and the writing system for the L2 they are studying. Such as in Azizifar's study, the participants utilized Consciousness Raising, where they focused on similarities rather than differences between their L1 and the other languages presented. Therefore, it is possible to conclude that when presented with an unfamiliar text, language learners will be more inclined to use the knowledge they have of their L1 to comprehend an L2.

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Sex-Selective Abortions: The Prevalence in India and its Ramifications on Sex Trafficking

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Introduction

Sex-selective abortion is a pratice involving the prenatal preference of males over females. Prior to the availability of ultrasound technology, this preference led to the abandonment or murder of female infants. However, with the increase in availability of ultrasound technology and the corresponding advance knowledge of the fetus' sex, the ability to perform selective abortions was introduced. The concept of sex-selective abortion can be viewed through the lens of sex ratio at birth. The natural sex ratio is about 102-106 males to 100 females.[1] However, the Indian cultural preference for males over females translates into a disproportionate sex ratio, in favor of males. This paper will examine the scale to which sex-selective abortions occur in India, the Indian government's attempts to stop the practice, and its relationship to sex trafficking within the country.

Sex-Selective Abortion in India

Despite other progress that has been made towards equality, a preference still exists for males over females within Indian society, due to parts of the population clinging to older cultural and discriminatory views. In the eyes of the law, men and women have equal rights as mandated by the Constitution of India. This idea of equality has been underscored by India being a signatory to the Convention on the Elimination of All Forms of Discrimination Against Women.[2] Nontheless, certain cultural traditions prevail, particularly those which involve the responsibility of the male child(ren) to support elderly parents, as well as other sex-exclusive religious practices.[3] This is in addition to systematic oppression of women that can be found within government institutions. Traditionally, Indian marriage culture dictates that the daughter's family giving a financial dowry to the groom's family.[4] Therefore, with the birth of a daughter, there is an implied future financial obligation that also places another cultural disadvantage on the female sex. Through this, the overall preference for males over females in India continues, and the financial and cultural catalysts for sex-selective abortions remain.

The rise of sex-selective abortion was propelled by the accessibility of prenatal ultrasound technology in the 1980s.[5] As a result of this technological advancement, a family could determine if the child was male or female and, based on this information, make the decision to either keep the child or terminate the pregnancy. There has also been an observed trend in the decision to use sex-selective abortion in the future that is influenced by the birth order of children and the sex of the previous child. This decision-making pattern is best represented through the measurement of sex ratio at birth (SRB). If the first child was a girl, the parents would use sex-selective abortion methods for a subsequent pregnancy, causing the SRB in India to grow to 132 males to 100 females. If the first two children were girls, the SRB would increase to 139 males to 100 females for the third birth, whereas the SRB would be normal if the preceding child or children were male.[6] In essence, the presence of a female child would increase the practice of sex-selective abortions in successive pregnancies and cause parents to force the birth of a male child artificially. However, if males were

1 UNFPA, "Gender-Biased Sex Selection," https://www.unfpa.org/gender-biased-sex-selection (accessed November 22, 2018).
2 D. Amutha, "The Roots of Gender Inequality in India," Tuticorin, India: St. Mary's College (2017): 6, https://dx.doi.org/10.2139/ssrn.2906950 (accessed November 22, 2018).
3 Ibid., 5-6.
4 Therese Hesketh, and Zhu Wei Xing, "The Consequences of Son Preference and Sex-Selective Abortion in China and other Asian Countries," *Canadian Medical Association Journal* (2011), https://doi.org/10.1503/cmaj.101368 (accessed November 22, 2018).
5 Therese Hesketh, and Zhu Wei Xing, "Abnormal Sex Ratios in Human Populations: Causes and Consequences," *PNAS* (2006): 13272, https://doi.org/10.1073/pnas.0602203103 (accessed November 22, 2018).
6 Hesketh, and Xing, "The Consequences of Son Preference and Sex-Selective Abortion in China and other Asian Countries."

born, Indian parents would be less motivated to rely on sex-selective abortions in the future.[7] This observed trend provides critical insight into the corresponding impact of sex-selective abortions throughout India.

The consequences of ultrasound technology are also observable in terms of the sex ratio and the disparity between the number of expected and actual girls in the population. In the zero to six-year old demographic, there are only about 940 girls for every 1,000 boys throughout India. This ratio stands in contrast to the zero to six age demographic of the world, which stands at 986 girls per 1,000 boys.[8] Given India's position as the second-most populous country in the world (and projected to become the most populous in 2027), the accumulating nature of a skewed sex ratio has an immense impact.[9] The 2011 census conducted in India indicated that among girls zero to six years of age, there were about seven million fewer girls than expected, given the natural outcomes of birth.[10] Furthermore, when applying those same effects onto every age demographic in India, the impact on the population as a whole becomes even larger. The 2018 Economic Survey, which was presented to the Indian Parliament while discussing the budget, observed that the skewed sex ratio had contributed to 63 million missing women in the country.[11] The massive absence of women in the population emphasizes the magnitude of the overall issue that society creates through the favoring of males over females and sex-selective abortion.

Combatting Sex-Selective Abortions: The Indian Government

Due to the continued population impact from sex-selective abortions, the Indian government has taken steps to combat its occurrence. The first legal measure implemented by the Indian government was the Medical Termination of Pregnancy (MTP) Act in 1971. This act outlaws abortion, making it a criminal offense punishable by fines, imprisonment, or both. The only exceptions to this law are in cases where the life or health of the mother is at risk, the unborn child faces the potential for harm and serious disabilities, or if the pregnancy is caused by the failure of a contraceptive method. The law also places restrictions on legal abortions by mandating that they take place in a government hospital and by creating increased restrictions as a pregnancy progresses.[12] The Indian government also enacted the Pre-natal Diagnostic Techniques (Regulation and Prevention of Misuse) Act, known as the PNDT Act of 1994. This legal measure outlaws most uses of prenatal diagnostic techniques, such as ultrasound technology that can detect abnormalities and disorders in the fetus, "for the prevention of their misuse of sex determination leading to female feticide."[13] Through its regulations, the PNDT Act has created a legal barrier towards knowing the sex of a child before birth to prevent sex-selective abortions. If the legal measures were sufficient, it would be expected that after the passage of the 1971 MTP Act and the 1994 PNDT Act, the demographic trends in India would shift towards the natural sex-ratio at birth.

Nevertheless, it has become evident that the legal repercussions have not completely deterred people, as sex-selective abortions are still occurring. Despite the government's attempts in banning prenatal diagnoses and strictly regulating the permissibility of abortions, there are clear indications that these laws are not being strongly enforced, given the continued disparity in sex ratio at birth throughout the country.

It is difficult to ascertain the exact number of sex-selective abortions in India, given the illegality of

7 UNFPA, "Trends in Selective Abortions of Girls in India," United Nations Population Fund (2011), https://www.unfpa.org/resources/trends-selective-abortions-girls-india (accessed November 22, 2018).

8 Corey Flintoff, "Selective Abortions Blamed for Girl Shortage in India," NPR, April 14, 2011, https://www.npr.org/2011/04/14/135417647/in-india-number-of-female-children-drops (accessed November 22, 2018).

9 Hannah Ritchie, "India will soon overtake China to become the most populous country in the world." Our World in Data, April 16, 2019, https://ourworldindata.org/india-will-soon-overtake-china-to-become-the-most-populous-country-in-the-world#licence (accessed May 24, 2020).

10 Lisa R. Roberts, and Susanne B. Montgomery, "India's Distorted Sex Ratio: Dire Consequences for Girls," *Journal of Christian Medicine* (2016), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5341607/ (accessed November 22, 2018).

11 Shweta Sengar, "Decline in Sex Ratio at Birth Indicates Rampant Gender-Selective Abortions in India," *India Times,* February 19, 2018, https://www.indiatimes.com/news/india/decline-in-sex-ratio-at-birth-indicates-rampant-gender-selective-abortions-in-india-not-enough-beti-bachao-339969.html (accessed November 22, 2018).

12 Krishnan S. Nehra, "Sex Selection & Abortion: India," Library of Congress, June, 2009, https://www.loc.gov/law/help/sex-selection/india.php (accessed November 22, 2018).

13 Nehra, "Sex Selection & Abortion: India."

the practice and the lack of reporting on sex-selective abortions.[14] However, in a 2019 report created by the Population Research Institute, three models were used to estimate the number of sex-selective abortions through a comparison of the observed and expected sex-ratios at birth. Through this study, it is estimated that as many as 20.2 million women have been lost between 1990 and 2018 due to this practice.[15] The statistics imply that despite the legal consequences, techniques are still being used to determine the sex of the fetus and decisions are being made accordingly to terminate pregnancies. It can be inferred that this is especially true in situations where a family has enough wealth, influence, and power for access to illegal ultrasounds. Ultimately, in spite of regulations that aim to end illegal abortions, India has failed to correct its demographic disparities, and its sex ratio continues to be adversely impacted.[16]

Sex Trafficking: The Accompanying Effect of Sex-Selective Abortions

The presence of sex-selective abortions in India ultimately creates a population in which there is a disproportionately fewer number of women than men throughout the country. The uneven gender demographics greatly affect the number of potential pairings for traditional heterosexual marriages. For marriages to occur, there must be a viable supply of partners in the marriage market. The marriage market, in this context, refers to the available population of marriageable individuals. In a culture that heavily encourages marriage during one's lifetime, the occurrence of sex-selective abortions leads to fewer women in the Indian marriage market.[17] As such, an environment exists where the supply of women is low and the demand for them remains high.

Due to the insufficient number of women, there is high potential for the presence of sex trafficking in India. The most prevalent permutation of sex trafficking is bride trafficking, a solution which fills the void in the marriage market. With a shortage of women in certain regions of India, traffickers turn to the deceptive recruitment and kidnapping of poor women to sell as brides.[18] Throughout the country, traffickers will use coercion and false promises of employment to lure young women from their families, before forcing them to engage in sham marriages both domestically and internationally (i.e. Arab states of the Persian Gulf).[19] This system of bride trafficking uses Indian regions with a more balanced sex ratio to supply victims for the regions with a more disproportionate sex ratio.[20] In 2012, the National Crime Records Bureau in India estimated that, just in the state of Assam, ten women are kidnapped each day.[21] The trafficked brides become victims of sexual abuse and are forced to conceive children for the individuals who have purchased them.[22] Furthermore, there are other factors that facilitate sex trafficking, including the size of the country and the large population, which allow for the internal transfer of women to various parts of the country. One particular factor that exacerbates the problem of sex trafficking is the prevalence of corruption across government offices and law enforcement agencies. Due to bribery, there is a financial incentive for officials to ignore the exploitation of women and protect traffickers from prosecution.[23] Such criminal activities allow for traffickers and other involved actors to more easily reap the economic benefits of the lack of women in society.

The connection between the reduced numbers of women and trafficking is not only limited to bride trafficking, for it also extends to the commercial sex

14 Jonathan Abbamonte, "Sex-Selective Abortions in India: Estimates on the Occurrence of Sex-Selective Abortions in India and Some Possible Solutions to Eliminate the Practice," *Population Research Institute* (2019): 5.

15 Ibid., 13.

16 Rahul Tripathi, "Survey shows sex ratio falling further to 896 in 3 years to 2017," The Economic Times, July 15, 2019, https://economictimes.indiatimes.com/news/politics-and-nation/survey-shows-sex-ratio-falling-further-to-896-in-3-years-to-2017/articleshow/70221462.cms (accessed June 27, 2020).

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19 "2019 Trafficking in Persons Report: India," U.S. Department of State, 2019, https://www.state.gov/reports/2019-trafficking-in-persons-report-2/india/ (accessed June 5, 2020).

20 Gierstorfer, "While India's girls are aborted, brides are wanted."

21 Ibid.

22 Heather Barr, "You Should Be Worrying about the Woman Shortage," Human Rights Watch, December 4, 2018, https://www.hrw.org/news/2018/12/04/you-should-be-worrying-about-woman-shortage (accessed June 6, 2020).

23 "2019 Trafficking in Persons Report: India."

market. The relative deficit of women in the country (and the accompanying surplus of men) has raised concerns that there will be a greater likelihood of men engaging in unhealthy sexual behavior, including commercial sex.[24] As the supply of women remains unable to meet the needs of society, the demand for a market of commercial intimacy increases accordingly. As is the case with any product in the economic market, the shortage of women increases the financial value that is associated with access to them. The commercial value of female sex workers and the societal need for women incentivize men to become more involved in the sex industry as traffickers and pimps. As more men engage and the shortage of women in the country continues, there will be an increase in the number of women, likely from the lower end of the socioeconomic spectrum, being trafficked into the commercial sex industry to meet the demands of society. One could infer that this trend, in turn, would fuel the growth of the industry.

The commercial sex industry exacerbates the shortage of women in the marriage market, which results in a continued increase in demand for the sex trafficking industry. Indian society attaches a stigma to women who are associated with the commercial sex industry, despite their involuntary participation. Therefore, amid an existing shortage of women, parts of the female population are perceived as being inferior or having limited potential in the event that they are able to escape the commercial sex industry and sham marriages. This has the possibility of placing an even greater strain on the marriage market, thus perpetuating the cycle and encouraging the illicit demand for a demographic that is already depleted because of the practice of sex-selective abortions.

Summation of Research

The research conducted about India and sex-selective abortions has demonstrated that the shortage of females is still a prevalent national issue that adversely impacts the population. The problem arises from the societal and cultural preference for male children due to their greater perceived value. In an effort to stop the practice of sex-selective abortions, the Indian government has passed legal measures banning the majority of abortions and the use of prenatal diagnostic technologies. However, as evidenced by the continued presence of sex-selective abortions, there are many opportunities to circumnavigate these legal barriers. The presence of sex-selective abortions in India has resulted in a sex-ratio at birth that has been skewed towards men. This disproportionate ratio causes a problem when it comes to other facets of society, such as the traditional marriage market. Consequently, the needs of a struggling marriage market create an environment conducive to the use of bride trafficking in various regions of the country. Over the past 20 years, India has also witnessed a growth in its commercial sex industry, a beneficiary of the country's sex trafficking networks. While it is difficult to isolate the disproportionate sex ratio as the determinative cause of the growth of the commercial sex industry, neighboring countries (e.g. China) have attributed increases in prostitution and trafficking to similar sex-ratio disparities.[25]

There is an implied relationship in India between the existence of sex-selective abortions and the existence of the bride trafficking market. A more balanced sex-ratio throughout the country would diminish the large need for such a market, and it can be speculated that instances of trafficking would fall as well. The disproportional sex-ratio, as a result of still prevalent sex-selective abortions, has ramifications on the presence of commercial sex trafficking throughout India. It also impacts the culture's progress towards gender equality, creating a larger obstacle to India's growth as a society and taking its place as a global leader. This comes at the same time that the participation of women in society is considered to be more important than ever, especially in the face of ongoing global crises.[26] Like all other countries, India has an international legal obligation to take action and prevent trafficking.[27] As this paper outlined, this is an obligation that can only be met by addressing a key source of this illegal practice: sex-selective abortions.

24 Kaur, "Mapping the Adverse Consequences of Sex Selection and Gender Imbalance in India and China," 42.

25 Therese Hesketh, and Jiang Min Min, "The Effects of Artificial Gender Imbalance," *EMBO Reports* 13, no. 6 (2012), http://embor.embopress.org/content/13/6/487 (accessed November 22, 2018).

26 UN News, "Women's participation in all aspects of society more vital than ever – UN officials," United Nations, March 8, 2012, https://news.un.org/en/story/2012/03/405852-womens-participation-all-aspects-society-more-vital-ever-un-officials (accessed June 9, 2020).

27 Joint UN Commentary on the EU Directive – A Human Rights-Based Approach, Human Rights, 2011, https://www.unwomen.org/-/media/headquarters/media/publications/en/uncommentaryeutraffickingdirective2011.pdf?la=en&vs=947 (accessed June 9, 2020).

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