Becoming Impossible:

The Social and Emotional Experiences of Watching and Learning to Perform Magic

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Declaration

I declare that the work presented in this Thesis is my own. All studies and work detailed in the text of this Thesis is novel and has not been previously submitted as part of the requirements of a higher degree.

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Dedication

First and foremost, I'd like to dedicate this thesis to Dr Michael Fordyce. We'll never meet in person, but your research and your online book that taught me the science of happiness is what turned my life around. It was the turning point that led to my meaningful pursuit of investigating the science of magic and wellbeing. The research of living the "good life" that you shared continues to live on through the lives you've changed.

I'd also like to dedicate the thesis to magicians who strive to use magic as a force for good.

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Thesis Abstract

This thesis set out to examine the social and emotional experiences of 1) learning to perform magic and 2) watching magic tricks, with a view toward wellbeing applications. To do so, the thesis begins with a comprehensive literature review on magic and wellbeing where I develop a novel hierarchy that acts as a foundation for understanding the wellbeing value of magic (Part I, Chapter 1). Further, I use theories from psychology literature to rationalize how magic could be relevant to wellbeing. Insights from this review informed the approach of the thesis, which begins by studying how learning to perform magic tricks affects 1) social aspects like community and 2) emotional aspects, such asself-esteem (i.e. feelings about one's self). Thus, in Part II of the thesis I conducted experiments utilizing real-world magic workshops from trained professionals in both child and adult samples (Chapters 2 and 3). I then extracted the portion of the workshop unique to magic to minimize confounding factors and investigated the unique impact of solely learning to perform the magic trick (Chapter 4). As predicted from the magic and wellbeing hierarchy, we observed that watching magic tricks was an important element of the magic learning process. In Part III, we subsequently break down this top-level process of learning magic tricks by examining how enjoyment of watching magic is related to perceived impossibility (Chapter 5), individual differences (Chapters 6 & 7), and the experience of wonder (Chapter 8). In Chapter 6 & 7 I explore how this enjoyment is associated with individual differences in personality, locus of control, and the emotion of curiosity. Then to conclude, I then break down enjoyment more specifically into the experience of wonder in Chapter 8 where I postulate a theory of wonder in magic that may involve the emotion of awe and conduct an experiment to determine which aspects of awe (if any) are most relevant to the experience of magic.

Introduction

Thesis topic and scope

The performance art of magic centres around the idea of making the impossible become possible. This thesis investigates impossibility through the lens of magic tricks by focusing on social and emotional aspects of watching and learning to perform magic tricks. Social and emotional aspects are defined broadly. For example, emotional aspects include feelings about one's self (e.g. self-esteem) and the emotional enjoyment of a magic performance as it relates to individual differences. Some examples of social aspects include social skills, a feeling of closeness to others, a sense of community, and one's perception of the socioemotional reaction when they perform magic. Insights from the review in Part I led me to emphasize social aspects more in Part II, which focuses on learning to perform magic. Likewise, insights from both the review and from Part II led me to focus more on emotional aspects in Part III where I focus on the experiencing of watching magic tricks. The general aim of the thesis is to evaluate and understand the unique benefits of wellbeing interventions that involve learning and performing simple magic tricks. This is achieved through a reductionist approach by breaking down the magic learning process into its core components (e.g. watching magic) and understanding what each component contributes to real world applications.

Structure of thesis

While the study of magic within psychology has gained much traction over the past decade (Kuhn & Jay, 2021; Rensink & Kuhn, 2015b, 2015a), hardly any of this research focuses on psychological wellbeing despite it being a form of entertainment that can elicit a healthy mix of emotion. Therefore, in Part I of this thesis, I review pre-existing magic programs and the prior empirical work that used magic tricks to enhance wellbeing in a broad range of contexts

(Bagienski & Kuhn, 2019). Chapter 1 puts forth a hierarchy that helps break down and organize the complex experience of learning to perform magic tricks and I suggest relevant theoretical frameworks from the field of psychology. For example, some studies involve participants watching magic whereas others had participants learning to perform the magic tricks. One of the most common findings was that a vast majority of applied programs and empirical studies focus on participants learning how to perform magic, hence the rationale to begin thesis experiments here. These empirical studies often found social benefits as well increases in self-esteem. The theoretical argument for why performing magic may enhance social relationships is based on how reactions to magic closely mirror social behaviours that encourage positive relationships, which subsequently reinforce the performer's behaviour via social validation. For studies on watching magic, the social and self-esteem benefits were absent from my review in that they were never measured. Instead, these studies often harnessed the power of magic tricks to elicit curiosity. Here, we put forth a theoretical rationale for why individual differences in curiosity may be relevant to magic enjoyment. Furthermore, we discuss how magic may elicit a sense of wonder, which we postulate to be an overlap between the emotions of curiosity and awe. However, we suggest that awe may only arise if the spectator imagines enough possible explanations for the magic trick, which are all proven to be wrong. These insights from the extensive literature review guided the remaining experiments in this thesis.

Part II of the thesis focuses on the impact of learning to perform magic tricks. I learned from the review that the most common application to wellbeing involved teaching magic tricks to children, thus this was the most logical place to begin with experiments. Furthermore, I learned that self-esteem and social skills were a common theme and therefore the most logical place to begin was by simply assessing these two aspects in children. Thus, in Chapter 2, we attempted this by running a feasibility study at a primary school with magic workshops delivered by Abracademy; a company that frequently delivers magic based workshops in real-world settings.

Some of the data collection proved to be rather impractical with the study likely being underpowered, but we nevertheless were able to glean insights from qualitative coding of interviews with the children. These interviews revealed that the children felt better about themselves but the results did not reveal any significant changes in how well they got on with others.

In Chapter 3, we evaluate the magic workshops in a first-year undergraduate context, since the primary school experiment had practical limitations. I chose first year undergraduates because self-esteem and social wellbeing is especially important for university students to have a psychologically healthy transition to university. This transitional period involves integrating one's adult identity, which challenges one's self-esteem. The study investigated how community magic workshops affect self-esteem, closeness to others, community of belonging, and wellbeing for first-year university students in London. Wellbeing was assessed via a life happiness measure as well as depression, anxiety and stress. Students were allocated to either magic workshops where they learned magic tricks or mindfulness workshops during their first university term. Measures were taken at baseline, post-intervention, and a one-month follow-up. Both groups improved on all measures except life happiness, but students who participated in the magic workshops perceived greater benefits than the mindfulness group. While the intervention was successful, it is important to note that the workshops contained possible confounds from the non-magic related activities that were part of the sessions.

Thus, in Chapter 4 I attempted to isolate the activity where students only learn to perform a magic trick and investigated a potential mechanism for how learning to perform magic may increase an individual's self-esteem. This chapter theorizes that self-esteem arose from beliefs about one's capabilities and that the process of learning to perform the magic trick acted as an actual mastery experience that is also perceived as impossible by spectators, thus containing advantages of both imaginal and actual success experiences. In part, this was due

to the conscious awareness of social reactions to a seemingly impossible event. Based on this, we had participants learn a simple magic trick to create an "imaginal mastery experience" and evaluated its impact on sense of mastery. The results suggest that the activity enhanced participants' personal sense of mastery. Participants also overestimated the difficulty of the trick, while their confidence in performing increased. A thematic analysis on how participants perceived their audience's social revealed that the magic trick involved surprise, curiosity and interest, confusion, and other positive emotions. Consistent with the idea of magic being socially reinforced, these emotions provided social validation of their newly learned skill.

As implied by both the new framework in my literature review and the experimental results in Chapter 4, the role of watching magic was important in the socioemotional validation of successfully learning to perform magic. In Part III[1], we argue that empirical investigations of watching magic ought to begin by understanding why people enjoy magic, since these positive (or mixed) emotions are likely to play an important motivational role that would be required to optimize psychological wellbeing applications.

Since impossibility is central to magic, Chapter 5 begins by examining the relationship between impossibility and magic enjoyment. This study used a magic trick where participants watched a live performance of a magic trick in which the magician balanced objects in progressively more impossible configurations. At seven different time points observers rated their enjoyment, and the extent to what they saw was impossible. Analyses revealed that participants' enjoyment of the magic trick was predicted by their perceived impossibility of the magic trick, and this relationship was independent of how much they enjoyed magic in general. Moreover, participants enjoyed the performance more as it became more impossible. However, once the magical effect was anticipated, enjoyment began to plateau while perceived

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[1] *Note*: The covid-19 pandemic occurred during Part III of the thesis, which limited the ability to collect further data on some of the in-person experiments.

impossibility continued to increase. These results are discussed in the context of people's aesthetic appreciation of magic and current arts appreciation models.

Acknowledging that individual differences could be present in how people enjoy magic tricks, Chapters 6 and 7 aim to explore which individual differences may play a role. Chapter 6 focuses on individual differences in personality and locus of control whereas Chapter 7 investigates individual differences in curiosity.

Chapter 6 focuses on individual differences more broadly by investigating whether the Big-5 personality traits and locus of control predict general magic enjoyment and magic enjoyment from not knowing the secrets. Results suggested that extraversion and internal locus of control predicted magic enjoyment whereas external locus of control from powerful others predicted enjoyment of not knowing. However, these should be treated with caution because there were cohort differences and the lack of replication between the individual samples may imply the study was underpowered. While extraversion had a slightly larger effect the findings may simply imply that these individual differences are minor and that magic can be universally enjoyed.

In chapter 7, we investigated individual differences in curiosity across varying degrees of secrecy based on insights from prior chapters. The literature review and the chapter on mastery revealed curiosity to be highly present and from Chapter 6 we recognized that enjoyment of "not knowing secrets" can be a rather more complex question. Therefore, I decided to ask participants about their enjoyment of secrets across three levels: never knowing secrets, figuring out secrets, and already knowing secrets. Due to the more complex relationships, I utilized a structural equation modeling approach to model these relationships. Results indicated that general magic enjoyment was predicted by enjoyment of both never knowing secrets and figuring out secrets. Enjoyment of never knowing secrets was predicted by thrill seeking curiosity whereas enjoyment of figuring out secrets was predicted by deprivation sensitivity.

Moreover, enjoyment of figuring out secrets was also predicted by enjoyment of already knowing the secret.

In Chapter 8, we examine awe: one of the most profound emotions that magic can elicit. In this chapter, I postulate a theory of how awe relates to wonder, highlighting two factors that may play a role in eliciting awe. The first factor is the performance elements. The second is the relationship between 1) the rate in which a spectator can imagine logical explanations to the magic trick, and 2) the rate in which magic moments occur during a performance. Results indicated that magic videos were consistently rated higher in enjoyment than the comparison video, but surprisingly neither experiment showed any differences in awe between the two performances.

Some chapters may contain background research that was repeated in prior chapters. This structure was chosen for two reasons. The first reason was to remind the reader of the background research most relevant to the study at hand, thus adding clarity to the chapter. The second reason was because some chapters have been submitted to peer review journals for publication. The hope is that this structure will add explicit clarity.

Part I: Magic, Health, and Wellbeing

Chapter 1.

The Crossroads of Magic and Wellbeing[2]

1.1 Abstract

In recent years, magicians and scientists have begun collaborating to gain insight into various psychological functions. However, one underexplored area is the use of magic tricks to enhance wellbeing. Several past and current magic programs have been used to enhance cognitive, emotional, social, and physical wellbeing. The application of these wellbeing-focused magic programs ranges from physical and psychological therapies to gang prevention, hospitals, and classrooms. A few have been empirically investigated and additional studies have also explored the wellbeing value of magic. These studies are reviewed in light of a proposed hierarchical model based on how magic was applied. Overall, methodologies need improvement but distinctions between levels of the hierarchy can still be observed and are discussed. Furthermore, the positive effects on wellbeing can be organised into interrelated physical, cognitive, social, and affective components that reflect existing theoretical frameworks on wellbeing. To conclude, possible mechanisms and theoretical frameworks based on more established psychological theories are discussed to help guide future research.

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[2] This chapter of the thesis has been adapted from the published, peer-reviewed version of the paper. See: Bagienski, S., & Kuhn, G. (2019). The crossroads of magic and wellbeing: A review of wellbeing-focused magic programs, empirical studies, and conceivable theories. *International Journal of Wellbeing*, *9*(2), 41-65.

1.2 Introduction

Magic is one of the most enduring forms of entertainment, and for thousands of years magicians have enchanted their audiences with their illusions. In recent years, magicians and scientists have started to collaborate to develop a science of magic (Kuhn, Amlani, & Rensink, 2008; Rensink & Kuhn, 2015a; Rensink & Kuhn, 2015b). This new approach has predominantly focused on magicians' deceptive methods and the experiences magic evokes, exploring a wide range of psychological functions (Kuhn et al., 2008; Macknik et al., 2008; Thomas, Didierjean, Maquestiaux, & Gygax, 2015). However, magic may also offer a valuable tool to enhance people's wellbeing in a wide range of areas. In recent years, several programs have been established that use magic to enhance both mental and physical wellbeing, but much of this work has been poorly documented and few connections have been drawn between these different approaches. Thus, the aim of this paper is to provide an up-to-date review of approaches that use magic to improve wellbeing and review them in light of the available empirical research. Moreover, we provide a novel progressive hierarchy that organises current research and intervention programs, which will hopefully prove useful as a framework for future research on magic and perhaps extend to other fields, since magic draws upon expertise from a wide range of domains (Rissanen, Pitkänen, Juvonen, Kuhn, & Hakkarainen, 2014). While there are likely some similarities with recent advances from other arts and wellbeing research (Fancourt, 2017), we hope this hierarchy proves particularly useful as a framework for future research on understanding these magic-based approaches to wellbeing and ultimately the most befitting applications.

The relationship to wellbeing can be partly understood by looking at the magical experience. Magic deals with fundamental psychological principles such as consciousness, belief, and free will (Kuhn et al., 2008; Macknik et al., 2008; Rensink & Kuhn, 2015a; Thomas et al., 2015), yet the experience remains poorly understood. However, in recent years,

interdisciplinary endeavours have started to uncover some key factors. Analyses from magicians (Ortiz, 1994), philosophers (Leddington, 2016), historians (Lamont, 2017), psychologists (Rensink & Kuhn, 2015a; Rensink & Kuhn, 2015b; Vidler & Levine, 1981) and neuroscientists (Parris, Kuhn, Mizon, Benattayallah, & Hodgson, 2009) all highlight one common explanation: magic elicits a conflict between what we believe to have experienced, and what we believe to be possible. This experience mirrors both Harris's (1994) work on child reactions to causal violations and Berlyne's (1954) distinction between epistemic and perceptual curiosity. The curiosity that naturally arises from this dissonance is particularly relevant to affective and cognitive domains of wellbeing. The affective components of the experience have also been described as a particular type of wonder (Lamont, 2017; Rensink & Kuhn, 2015a), as pleasant, humorous, and highly memorable, due to intense curiosity (Leddington, 2016), and as surprise being a major component of the curiosity (Parris et al., 2009; Vidler & Levine, 1981). Therefore, since knowledge-seeking positive emotions seem to be involved, watching magic tricks may enhance wellbeing via cognitive and affective domains. We will now shed light on some of these approaches, before discussing the empirical evaluations and theoretical frameworks.

1.3 Wellbeing-focused magic programs

There are currently many magic-based wellbeing programs implemented throughout health care. Open Heart Magic, for instance, uses magic as a means to console and empower hospitalised children by performing and teaching interactive close-up magic at bedsides so children can perform for family and staff (Hart & Walton, 2010). This approach focuses on humour for its healing benefits, whereas the interactive nature makes it practical. Similarly, academics have written on how this interactive component could inform medical practitioners about building rapport (Kneebone, 2017), gaining trust, enhancing likeability, and becoming aware of nonverbal signals affecting patients' decisions (Sokol, 2008).

In rehabilitation, we also find programs that employ magic in physical therapy. Rehabracadabra, for instance, delivers workshops to occupational therapists on how to use magic tricks in physical therapy, with the aim of motivating clients, treating disorders, and constructing innovative, client-centred treatments (Fisher, 2016). Similarly, Healing of Magic is an American Occupational Therapy Association approved program that teaches therapists tricks to use in their practice (see Harte & Spencer, 2014, for hand therapy analyses of the tricks). The program claims to facilitate daily living by improving attention, perception, cognition, motor skills, proprioception, speech, and psychosocial skills (Spencer, n.d.). David Copperfield's Project Magic also uses magic tricks as rehabilitative tools for physical, psychological, and social disabilities (Copperfield, 2013). Similarly, Breathe Magic motivates children with hemiplegia (a neuromuscular condition causing partial paralysis) to engage in intensive physical therapy by teaching them magic (Breathe Magic, n.d.). Rather than solely training therapists, however, Breathe Magic utilises magicians who work alongside therapists to incorporate therapeutic movements directly into the tricks.

Magic has also been used in prison rehab as a psychological therapy for addictions and maladaptive behaviour. Gareth Foreman's course combines magic with cognitive behavioural therapy (Foreman, 2016) to help disengaged prisoners to actively participate in therapy. For example, the therapist first performs a magic trick, after which they brainstorm solutions for the trick. This approach garners interest, acts as an ice breaker, and helps them identify strengths that can be used in more lawful ways of problem solving. Other combinations of magic with psychological therapy include school counselling (Bowman, 1986) and psychotherapy with children (Stehouwer, 1983).

In a similar vein, magic has been employed for societal wellbeing via gang and crime prevention. Streets of Growth is a charity that used street magic to gain trust with adolescents who are susceptible to a destructive future in gangs, drugs, and crime ("Darren Way," 2017;

"Streets of Growth," 2017). The rationale is that individuals who are easily lured toward destructive lifestyles are also attracted to magic because both involve showing off and gaining credibility amongst a group through deception. Thus, the charity states that street magic can offer a valuable tool to connect with these youngsters and begin the process of building long-term relationships that lead to more promising futures for them.

Finally, magic has been applied in schools, especially for disabled students (see Figure 1 below). Hocus Focus is a curriculum designed to motivate students with learning difficulties by utilising magic tricks, which teachers incorporate into their lessons. The program states that the magic creates curiosity and enhances self-esteem by giving students skills that their non-disabled peers cannot perform (Spencer, 2011), which mirrors Frith and Walker's (1983) rationale of teaching magic to empower handicapped students. Others have suggested that magic would also be useful for teaching science (Österblom et al., 2015) and psychology (Solomon, 1980) to non-disabled students.
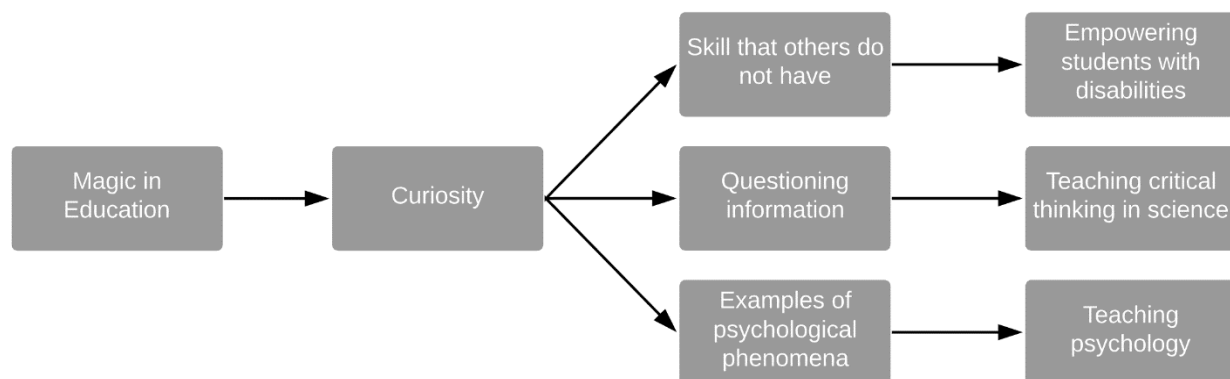
Figure 1. Rationales and applications of using magic tricks in education.

Whilst several active programs use magic to enhance wellbeing, only a few have been empirically evaluated (Green et al., 2013; Kwong & Cullen, 2007; Spencer, 2012; Sui & Sui, 2007), and few connections have been made between approaches. The focus of this paper now

turns to evidence in support of using magic to enhance wellbeing from an empirical and theoretical perspective, whilst providing a new framework to categorise the various approaches.

1.4 Overview of empirical studies

Despite the prevalence of active magic programs and suggestions from academics, the empirical evidence for using magic tricks to enhance wellbeing is still very young. To date, there has only been one review on the topic, but this was limited to health-care applications, found only eight empirical studies, presumed humour to be the only relevant positive emotion, and was mostly descriptive, offering little theoretical insight (Lam, Lam, & Chawla, 2017). We propose a more general approach and will discuss research on magic and wellbeing progressively, using the hierarchical model depicted (see Figure 2 below), with each level acting as a foundation for the next.

Teaching with
Magic

Performing Magic

Discovering Magic Secrets

Witnessing Magic

Figure 2. Progressive hierarchy stages for wellbeing effects of magic.

For example, witnessing a magic trick is required before learning its secret. Discovering the secret is required before one can perform magic. And performing experience is needed

before one can teach with magic by integrating meaningful lessons or messages into the performance. Thus, this review begins with studies on witnessing magic (without revealing secrets) and builds to ones where participants use magic tricks to teach (see Table 1 below for details on samples, measures and effect sizes for the studies). This final stage pertains to the effects on the individual teaching with magic. This progressive structure also suggests that the wellbeing effects from higher levels build upon and retain the effects from lower levels. Finally, to better understand distinctions between levels, these wellbeing effects are broadly organised into affective, cognitive, physical, and social domains.

Table 1

Summary of the Quantitative Measures Used, Types of Analyses, and Effect Sizes in Each Study

Reference	Sample size & type	Quantitative measures	Analyses	Statistical results with effect sizes (if applicable)
Witnessing Magic				
Labrocca & Piacentini (2015)	N = 100 three to twelve-year-olds	Oucher scale (Beyer, Denyes, Villarruel, 1992) to categorise if they felt venepuncture pain	Fisher's exact test	p = 0.0163, *φ = 0.261

Lustig (1994)	N = 266 self-selected students	5-point Likert items assessing AIDS knowledge and self-efficacy in prevention behaviours before and after magic show	*t*-tests on Likert items	Knowledge items:
				  Mosquitoes (p < .001, *d = 0.383)
				  Donate blood (p = .005, *d = .319)
				  Look sick (p = .007, *d = .304)
				  Latex condom (p < .001, *d = .319)
				  Take off condoms (p = 0.446, n.s.)
				Self-efficacy items:
				  Refuse sex (p = .003, .*d = 340)
				  Buy condoms (p = .524, n.s.)
				  Put on condoms (p < .001, *d = .319)
				  Take off condoms (p = .446, n.s.)

Moss, Irons, Boland (2017)	N = 224 participants crowdsourced from www.microworkers.com	Need for cognition scale (Cacioppo, Petty, Kao, 1984)
		
		Engagement via absorption subscale of Schoolwork Engagement Inventory (Salmela-Aro, Upadaya, 2012)
			One-way ANCOVAs controlling for age, sex, and education	Need for cognition:
				  $F(3, 217) = 2.74$, $p = .044$, $\eta^2 = .0014$.
				Engagement:
				  $F(3, 217) = 2.86$, $p = .038$, $\eta^2 = .0041$.
				
				Comprehension
				  $F(3, 217) < 1$, $p = .441$, $\eta^2 = .0011$.

		Comprehension test of tutorial material (6-item True/False)		
Peretz & Gluck (2005)	N = 70 three to six-year-olds with strong-willed behaviour	Time to dental chair Ability to take dental radiographs	t-test for time to chair Chi-square for radiographs	Time to dental chair (p = .001, *d = .864) Radiographs (p = .0013, *φ = 0.261)
Subbotsky (2010)	Experiment 1: Children N_1 = 28 4-yr-olds N_2 = 28 6-yr-olds (p = .009) N_3 = 28 9-yr-olds (p = .0002) Experiment 2: Adults N = 32 college students Experiment 3: Adults N = 34 college students Experiment 4: Adults N = 33 college students	Curiosity measured as proportion of participants who wanted to explore a magical vs counter intuitive non-magical effect, with varying levels of risk Response frequencies of whether or not participant acknowledged the possibility of true magic in what they saw	Fisher's exact tests	Experiment 1: Children 4-yr-olds (p = .0007, *φ = 0.658) 6-yr-olds (p = .009, *φ = 0.512) 9-yr-olds (p = .0002, *φ = 0.722) Experiment 2: Adults College students (p = .003, *φ = 0.529) Experiment 3: Adults Higher risk (p = .017, *φ = 0.417) Highest risk (p = .08, n.s.) Experiment 4: Adults Zero risk (p = .48, n.s.) Possibility of magic (p < .001, *φ = 1.215)
Subbotsky, Hysted, Jones (2010)	Experiment 1 N_1 = 25 4-yr-olds N_2 = 27 6-yr-olds Experiment 2 N_1 = 32 6-yr-old children N_2 = 32 8-yr-old children	Thinking Creatively in Action and Movement Test (Torrance, 1981) Blinded ratings of originality and non-reality for drawings of non-existent objects Magical Thinking Questionnaire (Bolton,	Two-way ANOVAs with summarised scores for Fluency, Originality, and Imagination as DVs t-tests for drawings	Experiment 1, Main effects of film: Fluency ($F_{1,48}$ = 14.14, p < .001; η^2 = 0.2) Originality ($F_{1,48}$ = 21.11, p < .001; η^2 = 0.3) Imagination ($F_{1,48}$ = 73.66, p < .001; η^2 = 0.6) Experiment 1, drawings by 6-yr-olds Originality score (p < .001; d = 2.2) Non-reality score (p < .001; d = 2.8)

		Dearsley, Madronal-Luque, Baron-Cohen, 2002)	Two-way ANOVA for Magical Thinking scores	Experiment 2, Main effects of film
				  Fluency ($F_{1,60}=14.95$, $p<.001$; $\eta^2=0.21$)
				  Originality ($F_{1,60}=22.63$, $p<.001$; $\eta^2=0.27$)
				  Imagination ($F_{1,60}=21.82$, $p<.001$; $\eta^2=0.27$)
				Experiment 2, drawings by 6-yr-olds
				  Originality score ($p<.01$, $d=1.5$)
				  Non-reality score ($p<.05$, $d=0.7$)
				Experiment 2, drawings by 8-yr-olds
				  No significant effects
				In all experiments, no significant effects for:
				  Interaction effects
				  Magical thinking scores

Vagnoli, Caprilli, Robiglio, Messeri (2005)	N = 40 Italian children	Modified Yale Preoperative Anxiety Scale (Kain et al., 1997) for child anxiety
		
		State-trait Anxiety Inventory (Spielberger, 1983) for parent anxiety
		
		Self Evaluation forms for clowns
			One-way ANOVAs
			
			Repeated-measures ANOVAs
			
			Pearson correlation coefficients
				Child anxiety during anaesthesia induction
				  **($F_{1,38}=14.896$; $p=.001$, *$\eta^2=.282$)
				Control group anxiety increase
				  **($F_{1,19}=21.253$; $p=.001$, *$\eta^2=.999$)
				Clown group correlation for child anxiety between waiting & induction room
				  ($r=0.93$; $p<.001$)
				Correlation of self-evaluations with child anxiety
				  Waiting room ($r=0.83$; $p<.001$)
				  Induction room ($r=.77$; $p<.001$)
				No other significant correlations or effects with parent anxiety

Discovering Magic Secrets

Danek, Fraps, von Müller, Grothe, Öllinger. (2014)	N = 42 adults	Ratings on 5 dimensions of insight moments experienced	Repeated measures ANOVA Pairwise post hoc comparisons of highest (happiness) and lowest (impasse) rated dimensions	Main effect of insight dimension $**(F_{4,41} = 16.43, p < .01, \eta^2 = .268)$ Post hoc comparisons: Happiness higher than all other dimensions (p < .05) Impasse lower than all other dimensions (p < .05)
Hilas & Politis (2014)	N = 77 students (34 students in control semester, 33 in semester with new teaching approach)	5-point Likert items in course evaluation surveys	*t*-tests between semesters *t*-tests between average of all other courses within department	**Between semesters (p = 1.43E-05, *d = .456) **Between courses (p = 7.25E-08, *d = .586)

Performing Magic

Ezell & Klein-Ezell (2003)	N = 26 children with disabilities	Self Image domain of Student Self Concept scale (Gresham, Elliott, Evans-Fernandez, 1993)	t-test comparing means before and after intervention	Increase after intervention (p < .001, d = .875)
Green et al. (2013)	N = 22 hemiplegic children	Assisting Hand Assessment (Holmefur, Aarts, Krumlinde-Sundholm, 2009) Children's Hand Experience Questionnaire (Sköld, Hermansson,	Repeated measures ANOVA	Assisting Hand Assessment: $(F_{2,19} = 8.87, p = .002, \eta^2 = .48)$ Children's Hand-use Experience Questionnaire: $(F_{2,19} = 12.93, p < .001, \eta^2 = .58)$

		Krumlinde-Sundholm, Eliasson, 2011)		No significant interaction effects

Kwong & Cullen (2007)	N = 5	EuroQol EQ-5D Health Questionnaire (EuroQol Group, 2005)
		
		Rosenberg Self-Esteem scale (Rosenberg, 1979)
		
		Rand 36-Item Short-Form Health Survey (Ware & Sherbourne, 1992)
			t-tests before and after intervention	EuroQol EQ-5D (p = 0.20, n.s.)
				
				Rosenberg Self-Esteem scale (p = 0.20, n.s.)
				
				Rand Health Survey subscales:
				  Energy/Fatigue (p = .02, *d = 1.436)
				  No significant changes for all other subscales

Levin (2006)	N = 6 resident adolescents in psychiatric hospital	Rosenberg Self-Esteem scale (Rosenberg, 1979)	n/a	n/a significance testing not calculated
Lyons & Menolotto (1990)		Affect and meaning of magic via response frequencies after the intervention only	n/a	n/a significance testing not calculated
Spencer (2012)*	N = 32 to 44 students	Hocus Focus Self-efficacy scale Rosenberg Self-esteem scale	Not reported; only a visual graph of means reported	n/a significance levels and means not explicitly reported

Sui & Sui (2007)	N = 40 schizophrenic and depressed patients	Chinese General Self-Efficacy scale (Chiu & Tsang, 2004)
		
		Personal Well-being Index (Cummins, Eckersley, Pallant, van Vugt, Misajon, 2003)
			t-tests on overall score before and after intervention
			
			t-tests on individual items of scales
				Self-efficacy (n.s. for overall score)
				  Question on identifying multiple solutions:
				  (p < .05, *d = .698)
				Personal Wellbeing Index (p < .05, *d = 0.370)
				  Question on interpersonal relationships:
				  (p < .05, *d = .482)

	Purdue Pegboard Test (Desrosiers, Hebert, Bravo, Dutil, 1995)		Question on society integration: (p < .05, *d = .554) Purdue Pegboard Left hand (p < .05, *d = .198) Right hand (p < .05, *d = .142) Both hands (p < .05, *d = .604)

Teaching with Magic

Papalaskari et al. (2006)	n/a Purely qualitative measures from focus groups and exit surveys	n/a no quantitative measures
Papalaskari et al. (2007)	n/a Purely qualitative measures from focus groups and exit surveys	n/a no quantitative measures
Spencer (2012)*	n/a Purely qualitative measures from teacher notes & surveys	n/a no quantitative measures

Note: For Lustig (1994), no standard deviations were reported, so effect size was calculated using degrees of freedom and t-statistic. An estimate of the t-statistic was obtained by using the quantile function in R statistical software. The abbreviation "n.s." indicates "not significant."

* Where effect sizes were not reported, we have manually calculated effect size from given data, if possible.

** These degrees of freedom or F statistics differ from what was reported in the original paper due to either typos or a likely misinterpretation of the analysis method used by the authors, which was confirmed via correspondence with the authors.

1.4.1 Witnessing magic

The first level of the hierarchy is the simple act of witnessing a magic performance. We will now discuss and evaluate the empirical evidence for effects of witnessing magic, which include both affective and cognitive components of wellbeing, predominantly as creativity, heightened curiosity and the ways this curiosity has been applied.

Enhanced curiosity in response to impossible events was observed in a series of empirical experiments where magical explanations to an anomalous event (the disappearance or destruction of an object) elicited more curiosity than those without a magical explanation, for both children and adults (Subbotsky, 2010). Effect sizes were large (see Table 1) and the curiosity to explore the anomalous event was influenced by the amount of associated risk. Similarly, Harris (1994) reviewed studies of children's reactions to unexpected, impossible events (e.g. magic tricks), concluding that whilst surprise is an element, it is only one part of an evolving reaction that ultimately leads to efforts in explaining the impossible event. This drive to acquire knowledge is also a defining feature of Berlyne's (1954) theory of epistemic curiosity, and reflects the curiosity framework of Kashdan et al. (2018), namely, the dimensions of joyous exploration, deprivation sensitivity (drive to solve problems), and stress tolerance (willingness to embrace distress from mysterious events). Thus, feeling intensely curious appears to be a predominant response to witnessing magic.

This curiosity from magic has also been applied as a pain or behavioural management tool, where tricks are used as a distraction therapy. For example, Labrocca and Piacentini (2015) showed that distracting children with magic tricks can reduce venepuncture pain. Another study in the hospital setting entailed clowns performing tricks for children to reduce pre-operation anxiety (Vagnoli et al., 2005) in the waiting room and during anaesthesia. Researchers and staff found this entertainment to indeed relieve children's anxiety, but staff felt it may not be practical, due to the clowns' interference with operating room procedures.

Magic as a distraction technique has also been used by dentists to deal with difficult to manage, strong-willed children (Peretz & Gluck, 2005). The experiment showed that magic tricks yielded significant improvements in the amount of time taken to enter the dental chair, the number of successful radiographs taken, and cooperativeness of children when compared to traditional "tell-show-do" techniques. The researchers did not investigate why it was effective but suggested that magic caused children to perceive the dentist as a playful and approachable ally, thus reducing anxiety at the core of the troublesome behaviour.

While enhanced curiosity appears to be characteristic of watching magic, this curiosity might be localised to the content within the trick itself, so care must be taken to ensure it does not distract from the intended focus, such as a teacher's lesson. Moss et al. (2017) investigated this effect by measuring (1) engagement during a lecture video, (2) motivation to think effortfully about an upcoming task (need for cognition), and (3) comprehension of the lecture content after participants first watched magic or circus videos, or did not watch videos. Results (see Table 1) indicated that not revealing the trick's secret decreased motivation to think effortfully but did not affect the comprehension test scores. The decreased motivation for effortful thinking was consistent with their hypothesis that ruminating on how the trick was done would distract from subsequent learning. Furthermore, engagement decreased when participants viewed the magic, which the authors attributed to the contrast of an interesting magic trick to less interesting lecture material. Therefore, while witnessing magic can enhance curiosity, it may not transfer to subsequent teachings, and a better approach may be embedding lessons directly into the trick's performance.

There is also evidence suggesting that witnessing magical content may enhance cognition through creativity. Subbotsky, Hysted, and Jones (2010) showed children films with either magical or non-magical content and found higher scores on creativity tests for participants who watched the magical scenes (see Table 1). While witnessing magical content and witnessing magic tricks

are not identical (Lamont, 2017; Leddington, 2016), they do, however, share the same component of watching impossible events. If this impossible event is responsible for enhancing creativity, we would therefore expect this effect to also transfer over to magic tricks.

Watching magic tricks has also been applied to public health in the form of an AIDS themed magic show for teenage students (Lustig, 1994), which was shown to increase self-efficacy for condom usage, AIDS knowledge, and the ability to refuse sex with small to medium effect sizes (see Table 1). However, since questionnaires were administered immediately after the show, we know little about its long-term impact.

In sum, witnessing magic may prove beneficial in enhancing cognitive wellbeing through increased creativity, perhaps affective wellbeing through self-efficacy, and both affective and cognitive wellbeing through increased curiosity. This intense curiosity appears to be prevalent in witnessing magic, which has been used as a distraction to manage perceived pain (Labrocca & Piacentini, 2015), anxiety (Vagnoli et al., 2005) or troublesome behaviour stemming from anxiety (Peretz & Gluck, 2005). When this attention-grabbing aspect is used to teach, however, it does not necessarily transfer to subsequent information presented, especially if secrets are withheld.

1.4.2 Discovering magic secrets

The act of discovering secret knowledge, as in a magic trick, may also enhance affective wellbeing. Danek et al. (2014) used magic tricks to investigate insight experiences. Participants repeatedly watched magic tricks until they figured out the secret, and both quantitative affective measures and qualitative self-reports were administered. The qualitative measures showed themes of physiological arousal, cognitive aspects related to problem solving, and emotional aspects related to happiness, tension-release, or pride. Of the quantitative variables, happiness (as measured via analogue scales between "unpleasant" and "pleasant") was the most characteristic of these insight experiences. Since this happiness came from problem solving, it may enhance both affective and cognitive wellbeing during the magic learning process, but future

studies are needed to clarify how this differs from simply being told secrets, with no active effort to discover secrets.

A more applied study used magic tricks to teach material in a computer science course (Hilas & Politis, 2014). The new teaching approach incorporated mathematical magic tricks, games, and drama as part of a new curriculum. They used a "mind-reading" trick where students mentally chose a number that the instructor could reliably reveal, with seemingly little information. Students were encouraged to discover how it worked, culminating with the instructor describing how the trick's secret utilised a computer science principle. Using a prior semester as the control, results showed significant increases in course evaluation scores (measuring positive affect as enthusiasm, interest, and motivation) with a medium effect size, raising it to the highest rated course in the department. While the inclusion of drama and games confounds effects from the magic trick, it is likely that at least some of the positive affect arose from discovering the secret to the magic trick (see Danek et al., 2014).

Overall, discovering secrets of magic may increase wellbeing through happiness, exhibited as pride or tension-release (Danek et al., 2014). This distinction builds upon the review by Lam et al. (2017) which highlighted humour as the predominant affective component. The study by Danek et al. (2014), however, clearly shows that humour is not the only affective component, because videos were devoid of humour, yet still enhanced happiness. As noted earlier, this encouragement to figure out magic tricks was also a focus of Foreman's (2016) cognitive-behavioural therapy program and of Hilas and Politis's (2014) new teaching approach, which showed increased positive affect in course evaluation surveys. While more research would help clarify the wellbeing effects of discovering secrets of magic, the available evidence suggests an impact on cognitive and affective wellbeing when discovering secrets of magic.

1.4.3 Performing magic

Most of the empirical studies on magic and wellbeing involve teaching participants to perform magic. As will now be seen, higher wellbeing is observed in affective, cognitive, physical, and social domains in these studies.

The first is an empirical evaluation of the aforementioned Breathe Magic program, which delivers intensive physical therapy through magic lessons during a 2-week summer camp (Green et al., 2013). Researchers measured hand-use of hemiplegic children and found improvements with a large effect size in independently performing bimanual tasks with the hemiplegic hand at both the end of camp and a 3-month follow-up. Subsequent data collected by Breathe Magic suggests that these improvements were also maintained at 6-month follow-up assessments (Breathe Magic, n.d.). Beyond physical wellbeing, researchers also observed positive feedback from the children and noted the importance of the communal context.

Meanwhile, the Healing of Magic program was investigated in two studies. The first involved 11 acquired brain injury patients (Kwong & Cullen, 2007) who were taught magic using the Healing of Magic manual and were interviewed about the program. Only five completed the quantitative questionnaires on quality of life, self-esteem, and general health, with results only showing significant improvement for items measuring participants' energy and fatigue levels. However, it is difficult to draw meaningful conclusions due to the small sample size.

The second study utilising the Healing of Magic program involved mentally ill patients (Sui & Sui, 2007). Hospital staff were trained on the therapeutic use of magic tricks, which they taught to patients. Researchers used a within-subject design to measure personal wellbeing, self-efficacy, and various motor skills. As outlined in Table 1, results showed small to medium effect sizes for personal wellbeing and motor skills. Although the overall score for the self-efficacy scale was non-significant, one particular question that did change significantly reflected divergent thinking, as also seen in the prior study on witnessing magic (Subbotsky et al., 2010).

Interestingly, the personal wellbeing scores were also driven by questions about social skills instead of curiosity. Interviews also revealed that patients felt motivated and engaged, and experienced many positive emotions. Taken altogether, motor skill improvements were attributed to consistent physical practice, whereas affective benefits appeared to be socially and cognitively driven.

Another study in the psychiatric setting entailed psychotic patients learning and practicing tricks, culminating in a final performance (Lyons & Menolotto, 1990). Researchers measured patients' affective perceptions and perceived benefits from the magic, with the highest rated affective item describing magic as "sociable." For the perceived benefits, the highest rated items were that it helped patients relax, learn something new, and feel worthwhile. However, the study had no statistical analyses, no pre-intervention measures, and a small, perhaps biased sample of only self-selected patients interested in magic. Furthermore, their illnesses may have created inaccurate responses. Despite the flawed methodology, however, it is interesting that affective measures showed sociability, mirroring results from Sui & Sui's (2007) study. This social component of performing magic may be a reasonable focus for future experiments on psychiatric samples.

One final study in the psychiatric setting involved a sample of pre-adolescent boys (Levin, 2006). Again, participants learned, practiced, and performed magic tricks. Pre and post intervention measures were taken, with results indicating numerical increases in self-esteem, and decreases in interpersonal boundary violations and timeouts. However, no confidence levels or significance tests were calculated, likely due to the small sample, thus warranting replication attempts with larger samples.

In the educational setting, Ezell and Klein-Ezell (2003) conducted an experiment with mentally and physically disabled elementary school students. Students were taught various magic tricks by older university students whose lessons followed Frith and Walker's (1983) guidelines

on teaching magic to handicapped children. These university students provided encouragement, helped the children practice, and measured their self-confidence. When both felt confident, children were given opportunities to perform for younger students and non-disabled peers. Results showed significant increases in self-confidence with a large effect size, which was attributed to magic giving the children an exclusive skill that their non-disabled peers lacked. In summary, this study provides some evidence that performing magic can increase affective wellbeing in disabled students.

A more comprehensive study in the educational setting utilised the aforementioned Hocus Focus curriculum (Spencer, 2012) with disabled students in three separate schools. An array of measurements was taken, which included interviews, journals, the Rosenberg (1979) Self-esteem scale and the Hocus Focus Self-efficacy scale, which were taken before, midway through, and after the course. Teachers also completed student observations, kept anecdotal records, were interviewed about their experience, and filled out questionnaires. Questionnaires varied, based on what the specific school wanted to improve, such as cognitive ability, social behaviours, frustration tolerance, or self-advocacy skills.

Qualitative results from both teacher- and student-reported measures reflected improvements in affective, social, and cognitive wellbeing. Affective wellbeing was observed in themes of enhanced self-determination, self-esteem, motivation, and other positive behaviours. Social wellbeing was observed as better rapport with students, better leadership and social skills, positive peer relationships, more participation, and students mentoring each other. Cognitive wellbeing was observed as improvements in engagement, concentration, memory, ability to follow directions, and curiosity (as already seen in witnessing magic). However, the social skill improvements were seen only in the schools that included the performing aspects, thus suggesting that social wellbeing only emerges from performing magic.

Overall, Spencer's study (2012) provides good qualitative evidence for using magic to enhance wellbeing in affective, social, and cognitive domains for a diverse sample of disabled students. Unfortunately, the quantitative evidence was only reported in a visual graph and only for one school. Further limitations include inconsistent methodologies between schools and no statistical significance testing, mirroring shortcomings in two of the psychiatric studies (Levin, 2006; Lyons & Menolotto, 1990).

In summary, social and motor skill benefits emerge when participants perform magic, while also retaining some affective and cognitive benefits from witnessing magic and discovering its secrets. Many different approaches have been used, but only a few studies (Green et al., 2013; Ezell & Klein-Ezell, 2003; Sui & Sui, 2007) had reasonable quantitative methodologies. This is not to say that the ample qualitative evidence (e.g. Spencer, 2012) is to be disregarded, but rather, that initial evidence shows enough positive effects to warrant further research.

1.4.4 Teaching with magic

Only a few empirical studies investigated the wellbeing effect on the teacher when implementing magic. First were the teacher interviews from Spencer's study (Spencer, 2012), which revealed that teachers felt more confident and effective at teaching, as well as more job satisfaction from both their own personal growth and the personal growth they contributed to within their students.

The second study utilised a 2-week summer camp designed to attract and retain student interest in science, technology, engineering, and mathematics careers (Papalaskari et al., 2006; Papalaskari et al., 2007). For the first week, older children were trained to mentor younger apprentices by learning science, theatre, magical illusions, and problem solving. These skills were used to create educational performances that centred around a Harry Potter inspired, "American School of Magic" theme. During the second week, these young mentors used their performances to teach science to apprentices, which embedded scientific explanations directly into the tricks.

Results from exit surveys and focus groups showed that mentors gained a deeper appreciation for science, theatre, and teaching careers, while both mentors and apprentices found it to be entertaining, exciting, and intensely enjoyable. Since these interviews were purely qualitative and only taken after the intervention, methodology was rather weak and it was difficult to draw firm conclusions. Nevertheless, one similarity we see in both of these approaches is a deeper appreciation of teaching, perhaps from witnessing the positive impact they had on their students.

1.5. Discussion

Applications for magic to enhance wellbeing in physical, affective, cognitive, and social domains are evident throughout both active programs and emerging empirical studies. These domains reflect some physical health outcomes in addition to the elements of wellbeing from Seligman's (2011, pp 16-25) wellbeing theory, namely, Positive Emotion, Engagement, Relationships, Meaning and Accomplishment (PERMA). We propose a progressive hierarchical model of magic and wellbeing that progresses from watching magic to teaching with magic. This model reveals unique benefits emerging at each stage, with at least some benefits retained and accumulated when moving up the hierarchy (Figure 2), namely, divergent creativity (Sui & Sui, 2007; Subbotsky et al., 2010) and qualitative evidence on the similar constructs of pride (Danek et al., 2014), self-confidence (Ezell & Klein-Ezell, 2003), and self-esteem (Spencer, 2012).

In the first stage of witnessing magic, positive emotions and engagement are exhibited as curiosity, interest, and its application as a distraction therapy. In the next stage, positive emotions and accomplishment are seen as happiness stemming from pride and tension-release when secrets are discovered. Additional improvements in social and motor skills only emerge once participants reach the stage of performing magic, which reflects relationships and perhaps more accomplishment in terms of the PERMA framework (Seligman, 2011). One distinction *between*

stages is that the use of magic as a curiosity-inspired distraction tool helps manage difficult children with inflated self-esteem, whereas learning to perform magic helps uplift children with low self-esteem. Only two studies investigated effects of teaching with magic where the only distinct benefit from prior stages was a deeper appreciation for teaching, which may reflect meaning in the PERMA framework (Seligman, 2011) because the teachers saw the positive impact contributed to their students.
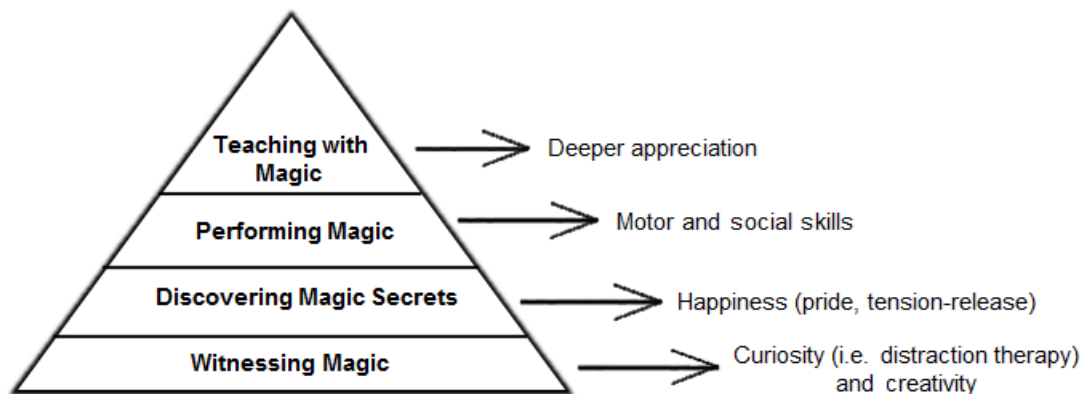
Figure 3. Magic and wellbeing hierarchy, highlighting the unique benefits that emerge in each stage in addition to those from lower stages.

These observations are not surprising, since elements of PERMA are moderately correlated (Goodman, Disabato, Kashdan, & Kauffman, 2018), but we do hypothesise magic to be particularly unique and useful in the high degree of curiosity it inspires, due to its secretive nature, and in its frequent reliance on both astute social skills and a broad spectrum of motor movements. However, future research is still required, since many studies lack scientific rigour, do not control

for third variables (e.g. humour, learning a new skill) and few investigated mechanisms for how magic specifically affects the building blocks of wellbeing.

Additionally, it is not clear whether certain benefits are more applicable for certain samples. For example, many samples involved children or handicapped individuals. However, some of the higher quality studies indicate that the ability to inspire intense curiosity (Subbotsky, 2010) and how that curiosity acts as a distraction (Labrocca & Piacentini, 2015; Peretz & Gluck, 2005; Moss et al., 2017; Vagnoli et al., 2005) are common in both healthy children and well-functioning adults who witness magic. Additionally, different types of curious people (Kashdan et al., 2018), might predict spectators who actively try to find the secret as opposed to those who watch passively. Finally, different genres of magic may yield different responses. Nevertheless, the current evidence will guide the remainder of this section, which discusses theoretical explanations that draw upon more established psychological research.

One overarching feature emerging from the empirical studies is the ability of magic to create curiosity and capture people's interest. This interest has been utilised in a range of domains, such as distraction therapies (Labrocca & Piacentini, 2015; Peretz & Gluck, 2005; Vagnoli et al., 2005), teaching in schools (Hilas & Politis, 2014; Spencer, 2012), and physical therapies (Green et al., 2013) as an engaging and motivating tool. It is likely that these approaches create intrinsically motivated experiences, since fun and positive emotions are often present, which are intrinsically motivating and pursued for their own sake (Jayawickreme, Forgeard, & Seligman, 2012). These experiences are also indicative of the joyous curiosity dimension in the curiosity framework of Kashdan et al. (2018), which relates to the joy of seeking out new knowledge and information. The other dimensions of curiosity might also be related, as discussed in the following sections, where different elements of wellbeing are considered, suggesting possible theoretical mechanisms at play in the hierarchy of magic and wellbeing.

1.5.1 Witnessing magic

As noted earlier, intense curiosity commonly results from witnessing magic. Curiosity, however, is more than an intellectually engaging phenomenon: it is an emotion that is often associated with positive affect via pleasurable exploratory processes (Csikszentmihályi, 1990; Kashdan et al., 2018; Kashdan, Rose, & Fincham, 2004).

This pleasurable exploratory process seen in magic would be the joyous exploration dimension from Kashdan et al.'s (2018) recent work where they consolidate the different perspectives in curiosity research into a scale that gave five distinct dimensions. Their analysis indicated that this type had the second highest association with wellbeing measures. The dimension they found most associated with wellbeing is stress tolerance, which entails a willingness to embrace doubt or confusion that arises from unexpected or mysterious events. Witnessing magic is an unexpected (Parris et al., 2009) and mysterious event, yet these intense emotions are experienced in a safe and entertaining environment (Leddington, 2017). Thus, the enjoyment and wonder from magic might help condition people's attitudes toward uncertainty and help them embrace this uncertainty. How to best use the curiosity from magic in learning environments is still unclear, but one important factor might be whether lessons are embedded either within the trick's performance or within its secret, as suggested by Moss et al. (2017). Further evidence for this suggestion comes from Gruber, Gelman, & Ranganath (2014), who showed that memory improved during states of high curiosity, and how students participate more when curious (Park, Tsukayama, Goodwin, Patrick, & Duckworth, 2017). Therefore, embedding lesson material within the presentation or explanation of a trick (rather than afterwards) could be a fruitful avenue for future research.

Another positive emotion that witnessing magic might elicit is awe. Keltner and Haidt's (2003) framework of awe has two main components that are relevant to magic: a need to assimilate the experience into one's current mental structures and a perceived sense of vastness. The need for

assimilation results from the cognitive conflict that is at the core of the magical experience (Lamont, 2017; Leddington, 2016; Rensink & Kuhn, 2015a). The second condition of perceived vastness is also met, because, as a spectator watches an effective magic trick, every possible explanation that they imagine would be disproven (Lamont, 2017; Leddington, 2016; Ortiz, 1994; Rensink & Kuhn, 2015a). Because of this, they become aware of a vast number of possible explanations that must exist, including an unknown correct one that exceeds their current knowledge. Thus, the spectator becomes cognisant of how limited their understanding truly is, even for very fundamental perceptions of our universe created by our senses. However, it is unclear whether this experience diminishes self-interest, as observed in other awe research (Bai et al., 2017), or whether it offers a unique exception. One possibility is that magic tricks elicit an emotion that lies at the intersection of awe and curiosity, namely, that of wonder. This positive emotion of wonder would align with both (1) observations of emotional gradients between awe and curiosity (Cowen & Keltner, 2017), and (2) a theoretical framework by Pritchard (Billingsley, Abedin, & Chappell, 2018) suggesting that the distinction between awe and wonder is that wonder has a participatory element.

Meanwhile, positive emotions may also explain how creativity increases from witnessing magic (Subbotsky et al., 2010). Creativity involves both divergent thinking where multiple ideas are generated, and convergent thinking where a selection from those ideas is made (Fürst, Ghisletta, & Lubart, 2014). Subbotsky et al.'s (2010) study on watching magical content focused only on divergent thinking, which aligns with the Broaden-and-Build theory of positive emotions (Fredrickson, 1998). This theory argues that positive emotions exist in order to broaden mental resources and build them over time. In the case of witnessing magic, the positive emotion of curiosity would broaden by generating multiple imagined realities for a magical film (Subbotsky et al., 2010) or by generating multiple imagined solutions for a magic trick, thus creating a motivation

to explore (Subbotsky, 2010). In both cases, curiosity comes from witnessing apparently impossible moments.

1.5.2 Discovering the secret of magic

The specific insight moment from discovering a trick's secret was also associated with happiness, as measured by analogue scales ranging from "unpleasant" to "pleasant," with qualitative reports showing that these positive feelings came from tension-release and pride (Danek et al., 2014). This is consistent with literature on solving other types of insight problems (i.e. verbal, special, or mathematical puzzles), in that positive affect is a core characteristic of insight experiences (Canestrari, Branchini, Bianchi, Savardi, & Burro, 2018; Topolinski & Reber, 2010). Hilas & Politis (2014) also explicitly instructed participants to discover the secret, and while the effect of this encouragement is still unclear, the urge to discover the secret might naturally be motivated by the curiosity from watching magic tricks, regardless of instruction.

Once the secret is discovered, an insight experience occurs, with the emotion of pride and a sense of accomplishment that seems to emerge at this stage. This pride, along with the initial curiosity, may then create desire in replicating the trick oneself, thus motivating the learning and performing of the trick.

1.5.3 Performing magic

One of the most apparent uses for learning and performing magic is to increase physical wellbeing through developing motor skills in physical therapy. Magicians use sleight of hand and carefully controlled body language to achieve the necessary deception for the magical effect. The sleights involve ultra-fine dextrous movements, whereas the magician's misdirection via his gaze, gestures, or body angle involves larger bodily movements. Because of this wide range of both

fine and gross physical movements, the design of magic tricks can be effectively integrated with physical therapy exercises.

However, there is likely more than just the physical movements that can explain the physical health outcomes. The art of magic is a form of entertainment, and therefore witnessing magic contains a great deal of positive emotions, which may play a role in two ways. Firstly, these positive emotions would motivate individuals to carry out the monotonous tasks of physical therapy under the guise of fun and engaging magic lessons (presumably via curiosity, awe, or pride from insight experiences). Secondly, once the learning begins, the positive emotions themselves may contribute to physical health. Positive emotions have been linked to a wide range of beneficial physical health outcomes that may operate on fundamental physiological processes (Diener, Pressman, Hunter, & Delgadillo-Chase, 2017). These include resistance to infectious disease (Cohen, Alper, Doyle, Treanor, & Turner, 2006), reduced risk of heart disease (Davidson, Mostofsky, & Whang, 2010; Tindle et al., 2009) and lower all-cause mortality (Xu & Roberts, 2010). Therefore, these beneficial physiological effects of positive emotions may also extend to physical therapy outcomes. If so, the presence of positive emotions when watching, learning, or performing magic tricks would further explain their effectiveness in enhancing physical wellbeing via motor skills (Green et al., 2013**;** Spencer, 2012**;** Sui & Sui, 2007), and reducing venepuncture pain (Labrocca & Piacentini, 2015).

Additionally, performing magic up close could be a good fit for enhancing social relationships by utilising social skills that encourage positive relationships (Spencer, 2012; Sui & Sui, 2007). Two prominent features of positive relationships are the act of sharing good news and responding to it actively and constructively (Gable, Reis, Impett, & Asher, 2004; Gable, Gonzaga, & Strachman, 2006). These active constructive responses are characterised by enthusiasm and encouraging the bearer of good news to relive that moment, thus capitalising on the associated positive emotions. These responses may account for why the improved relationship skills

emerged only in studies teaching participants to perform magic. As previously noted, magic tricks elicit curiosity, especially if a magical causation is suggested (Subbotsky, 2010). This curiosity reflects the constructive part of an active constructive response, where the person genuinely wants to learn more about the good news. In the case of magic, the "good news" is the ability to execute a trick successfully, which is shared by performing it. Moreover, surprise is a strong candidate for the experience of watching magic tricks (Harris, 1994; Parris et al., 2009; Vidler & Levine, 1981). When this surprise is combined with positive affect, the resulting emotion resembles enthusiasm, which is the remaining part of an active constructive response. Therefore, the nature of performing magic tricks is hypothesised to enhance social wellbeing by encouraging active constructive responses, which cultivate positive relationships (Reis et al., 2010) and may partially explain the unique manner of how magical expertise is predominantly developed from informal social settings (Rissanen et al., 2014).

Once these active-constructive responses are initiated, the close-up magician will surely see the emotional reaction of spectators, because the deception for magic tricks often requires making eye contact. Eye contact also triggers mimicry of facial expressions between two individuals, which in turn creates a synergistic, embodied experience of the emotions (Niedenthal, Mermillod, Maringer, & Hess, 2010). Therefore, the magician *also* experiences the spectator's positive emotions, which then reverberates back and forth between performer and spectators throughout the performance, thus creating an upward spiral of positive emotions. As a result, a positive rapport occurs, which could ultimately grow into meaningful relationships, as positive emotions are crucial for their formation (Waugh & Fredrickson, 2006). The link between such relationships and lifetime psychological wellbeing is also well established (Lyubomirsky, King, & Diener, 2005), so one mechanism for performing magic to increase wellbeing is hypothesised to be the cultivation of social relationships. One important distinction, however, is that these social

wellbeing improvements would presumably be stronger for small, live audiences where eye contact is less restricted, compared to video-recorded or larger stage performances.

Other benefits of performing were increases in pride, confidence and self-esteem (Ezell, & Klein-Ezell, 2003; Spencer, 2012; Sui & Sui, 2007), but there are limitations on understanding their source. For example, pride may arise from a successful performance, or from successfully guessing secrets to magic tricks, as in Danek et al.'s (2014) study. It is also unclear whether these wellbeing benefits stem from practicing the tricks or performing them, since none of the studies controlled for this distinction.

1.5.4 Teaching with magic

One final, unclarified distinction is whether teaching with magic performances yields any unique benefits beyond those of performing magic. When children used magic to teach younger children, it resulted in deeper appreciation for the professions involved (Papalaskari 2006; Papalaskari, 2007). Similarly, the qualitative data from teachers in Spencer's (2012) study indicated a deeper appreciation of teaching. In both instances, the participants contributed an enjoyable learning experience to their students, which resembles the meaning element of the PERMA framework (Seligman, 2011), because meaning in this framework is indicative of serving something greater than the self (i.e. the students). Therefore, this meaningful appreciation of teaching might come from a noble sense of contribution rather than positive affect. While this may not necessarily be unique to magic, the added aspect of paying forward the benefits of witnessing magic to others nevertheless makes it a worthwhile line of future research.

1.5. Conclusions and implications

Magic is an ancient entertainment form, and in the last decade we have witnessed growing scientific interest in understanding the experience of magic (Leddington, 2016; Lamont, 2017; Rensink & Kuhn, 2015a), as well as cognitive mechanisms that enable magicians to create these unique experiences (Kuhn, Caffaratti, Teszka, Rensink, 2014). The science of magic has started to build bridges between the scientific community and magicians' applied psychological knowledge and experience. As seen in this review, magic has also been used to enhance wellbeing in physical, affective, cognitive, and social domains throughout both active programs and emerging empirical studies. In both, we observe the use of magic as a motivating tool. A common application for these programs is physical therapy, but other settings include schools, hospitals, psychological therapy, and lifestyle intervention. Empirical studies show positive effects, but many have weak methodologies, warranting further research.

Despite the shortcomings, we have observed that witnessing magic enhances affective and cognitive wellbeing by inspiring intense curiosity and interest, which have been used as a distraction therapy. We believe that this ability to capture interest, along with feelings of awe, may be fundamental to the emotional experience of well-performed magic. This combination of curiosity and awe can be thought of as wonder. Thus, magic would be ideal for future research avenues on the scientific study of wonder. The timing for such research is also opportune, considering the recent strides in measuring both curiosity (Kashdan et al., 2018) and awe (Yaden et al., 2018). The implications of such research in positive psychology interventions are large, as the first step is capturing interest so that individuals can fully focus on what matters. Additionally, it is possible that the wellbeing benefits of curiosity and awe transfer to experiences of wonder. For curiosity, the dimensions most relevant might be joyous exploration, stress tolerance, or deprivation sensitivity, with the former two having strong associations with wellbeing (Kashdan et al., 2018). For awe, some wellbeing benefits include increased prosocial

behaviour (Piff et al., 2015), enhanced attention (Sung & Yih, 2016), decreased aggressive behaviour (Yang, Yang, Bao, Liu, & Passmore, 2016), and creative benefits (Liberman, Polack, Hameiri, Blumenfeld, 2012). Other fruitful avenues in witnessing magic may include how individual differences in curiosity relate to the enjoyment of magic, as well as which factors in a performance lead to which types of curiosity.

Similarly, discovering secrets of magic was linked to wellbeing, as pleasant emotions from insight experiences. Performing magic builds upon these effects by showcasing improvements in social and motor skills, while retaining at least some aspects from prior stages. Thus, magic might be useful as an interesting and enjoyable type of social skills training for captivating team building experiences in the corporate space. Finally, using magic to teach might cultivate a deep sense of meaning and appreciation for one's teaching contributions. During each of these stages, there appears to be a sense of wellbeing, motivating progress toward the next stage. In this review, we offered a new framework that helps structure these different approaches, and also suggested some theoretical models that may account for the positive effects and potential hypotheses.

Many avenues of magic and wellbeing are still largely unexplored. Well-designed experiments will help greatly in clarifying the psychological mechanisms at play. Moreover, we hope that the new theoretical insights in our understanding of magic will further help this process. Characterising the emotional and social experiences of magic would provide an excellent foundation, since magic is commonly used as an enjoyable, motivating tool in social settings. This solid foundation could then be used to investigate its interactions with physical or cognitive wellbeing, and further clarify whether wellbeing emerges through processes such as positive emotions and active-constructive responding, or perhaps guide us to more unexpected mechanisms. In doing so, the existing wellbeing-focused magic programs can better capitalise on the most useful aspects of magic tricks, professional entertainers can gain better

professional opportunities, and perhaps new, more effective and more inclusive approaches will be created that help both the disadvantaged and the general public to lead more meaningful, flourishing lives.

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Part II: Learning to achieve the Impossible

Part II Introduction

One of the most apparent observations from the comprehensive literature review in Part I was that the majority of applied magic programs involved learning to perform magic tricks. It is no surprise, therefore, that most of the empirical papers in the review also focused on learning to perform magic. Thus, research on learning to perform magic would be most useful for meaningful real-world applications, which is why Part II of my thesis focuses on learning to perform magic. Furthermore, by starting with studies on learning to perform magic, we can not only replicate certain findings from prior research, but we may also gain further insight into what's most important within the multifarious process of learning to perform magic. Using the literature review from Part I as a foundation, the two areas with stronger evidence were the social aspects and self-esteem when learning to perform magic, which will be a focus in the following experiments.

Chapter 2: Growing up with Magic: An arts based program for enhancing self-esteem and social skills

2.1 Abstract

There has been increased interest in applying the arts to health and educational contexts, and magic is a particularly unique performance, which has been rather understudied. As noted in Chapter 1, most empirical studies that do exist imply that teaching magic tricks to disadvantaged children may help enhance self-esteem and social skills. A total of 46 children from a London primary school were preselected by teachers, based on criteria for mild concern in areas of confidence and social interaction. Half took part in 8 weekly magic classes whereas the remaining half continued school as usual. Magic classes centred around the theme of belief, incorporating different exercises and techniques to improve the magic tricks and to help children impart belief in the tricks they learned, in themselves, and in others. Quantitative Measures of social skills and self-esteem were taken at baseline before the classes and again at the end of the program where structured qualitative interviews were conducted with students in the magic group. Results from the pre and post quantitative measures did not yield significant differences, possibly due to the lack of statistical power or methodological difficulties. Results from interviews, however, indicated that the magic classes were well received and had a positive impact on children's self-esteem. The impact on social skills was inconclusive. Future experiments would benefit from investigating larger samples with low self-esteem and testing whether the impact replicates with developmentally healthy children or by expanding to other age groups. [3]

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[3] This chapter has been prepared for publication in an academic journal. At the time of this writing, it is not submitted for publication to a journal.

2.2 Introduction

The arts are a powerful, precious and prevalent component of society. Not only do we see this in music, museums, and movies, but also in the artistic design of cities, landscapes, and everyday office environments. Furthermore, the value of the arts is evident from their impact on the economy, health, society and education (Mowlah et al., 2014). Yet, scientific interest in the arts has only recently begun to resurface, with many research applications in both wellbeing (Fancourt, 2017) and educational contexts (Jindal-Snape et al., 2018).

One particularly unique art that focuses predominantly on creating impossible experiences is the performance art of magic. The scientific study of magic has expanded greatly over the past decade (Kuhn, 2019; Kuhn et al., 2008; Rensink & Kuhn, 2015a, 2015b) and empirical interest is now expanding to applied areas such as wellbeing and education (Bagienski & Kuhn, 2019; Lam et al., 2017; Wiseman & Watt, 2018). This research expansion into educational contexts includes assisting students with learning challenges (Ezell & Klein-Ezell, 2003; K. Spencer, 2012), teaching computer science (Hilas & Politis, 2014), developing evaluative measures for using magic in educational and health settings (O'rourke et al., 2018; Kevin Spencer et al., 2019), promoting interest in STEM careers (Papalaskari et al., 2007), learning English as a second language (Ikhsanudin, 2017; In, 2009; Spencer, 2019), enhancing social skills (Godfrey & Wiseman, 2008), teaching psychology (Kuhn, 2019; Solomon, 1980) and critical thinking (Österblom et al., 2015), and how to make teaching with magic effective (Moss et al., 2016). However, much of this interest is speculative and the few empirical studies that do exist often lack empirical rigour, such as a lack of control group or not clarifying whether benefits emerge from prerequisite stages of learning magic (Bagienski & Kuhn, 2019; Wiseman & Watt, 2018).

Nevertheless, teaching children magic tricks as a motivating way to enhance global self-esteem was a common theme in prior research on learning to perform magic, which could be especially useful for populations suffering from low self-esteem by increasing engagement in

therapies through the intense curiosity magic evokes (Bagienski & Kuhn, 2019; Leddington, 2016a). Enhancing self-esteem through magic typically involves giving children an impressive skill that others cannot perform (Frith & Walker, 1983), which speaks to two common theoretical causes of self-esteem. First is the cause put forth by James (1892) on how self-esteem arises from one's perceived success in valued domains. Learning magic fits this criteria since magical content is valued by both children and adults, as evidenced by experiments showing that tricks presented with a magical causation are more interesting to explore (Subbotsky, 2010). Furthermore, since people are driven to figure out how a trick works, this may suggest that learning the secret is a valued domain and, therefore, successfully learning to performing magic would increase self-esteem. Within this self-esteem framework, autobiographical memory also contributes to the continuity of the self by establishing a personal narrative that can be contrasted to others (Nelson, 2003) and since magic often evokes curiosity (Bagienski & Kuhn, 2019), learning magic may become more salient in one's personal narrative. Lastly, people tend to set their aspirations in the realm of possibility. Thus, at a certain imaginary level, learning to do the impossible would necessarily *exceed* one's aspirations. Yet, this experience is also somewhat grounded in reality since social reactions to magic tricks often imply that the impossible became possible.

This latter social aspect also aligns with Cooley's (1902) "looking-glass" model of self-esteem where the self is created from opinions of significant others who act as a social mirror. This idea of a social mirror may also be useful in explaining why improved social skills emerged only in studies where participants learned to perform magic but not in studies on watching magic (Bagienski & Kuhn, 2019). One rational is that reactions to magic mimic the interested, enthusiastic active-constructive responses that act as social validation and form a basis for positive relationships (Bagienski & Kuhn, 2019; Gable et al., 2004, 2006). Another theory comes from how magic is the only art form that deliberately uses speech and social cues for its

misdirection (Scott et al., 2018) and can thus be a natural fit for improving social skills. Understanding these mechanisms better would be useful for both interventions that mitigate the problems associated with poor social skills (Greene et al., 1999) and for cultivating proficient social skills to form supportive relationships that are crucial for high wellbeing (Lyubomirsky et al., 2005).

Thus, the present study aims to investigate magic as a tool for self-esteem and social skill development in children in an exploratory manner. Firstly, it improves the empirical rigour of prior studies by utilising a control group, as prior experiments often had only before and after measures. Additionally, it focuses predominantly on the transition from early-to-middle childhood (ages 5 to 7) to middle-to-late childhood (ages 8 to 10) as this developmental stage is when the self becomes more continuous, perspective-taking starts to emerge and the children's overly positive self-representations start becoming more accurate (Harter, 2012b). However, this greater accuracy also makes children realize they can possess both favourable and unfavourable attributes, thus leading to self-perceptions in middle childhood becoming more negative compared to younger ages (Harter, 2006; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). Lastly, the current study expands on prior literature by incorporating a sample of children with less stringent areas of concern compared to prior studies looking on magic and self-esteem that predominantly involved children with more severe disabilities.

2.3 Methodology

2.3.1 Participants

A total of 46 British children (mean age = 8.13 years, SD = 1.11) were recruited from a primary school in London, United Kingdom. Letters were sent out to obtain parental and guardian consent for the children to participate. Children were chosen by using a checklist from The National Pyramid Trust that teachers filled out for their students. The checklist aims to bring areas of

concern to the fore about individual children. For this experiment, children were selected based on the items asking if the child "Can adapt confidently to new situations?" and "Appears to be inhibited?". If teachers indicated that the child struggled in one of these areas, they were eligible for the study as prior experiments typically involved handicapped children (Ezell & Klein-Ezell, 2003; Godfrey & Wiseman, 2008; Kwong & Cullen, 2007; Levin, 2006; K. Spencer, 2012).   While the majority of these children did not have diagnosed disabilities, we anticipated the magic lessons to still have a positive impact as some studies utilising magic tricks observed favourable outcomes in healthy functioning children (Papalaskari et al., 2006; Papalaskari et al., 2007). The children were randomly allocated to the magic or a control group, but ensuring that equal number of children from each class were in each group. Chi-square tests confirmed the sample had boys and girls equally distributed across treatment groups. Independent sample t-tests also confirmed that the ages between groups did not differ significantly, $t(44) = 0.04$, $p = 0.85$.

2.3.2 Procedure

The children were taught magic tricks over the course of 8 weeks on Friday afternoons during school hours. Classes were given weekly by Abracademy, a company that blends learning design and facilitation techniques with the teaching of magic tricks. Classes began with a "check in" that involved an icebreaker question for each child to answer, followed by a magic performance, teaching and performing a simple magic trick, and a "check out" where each child shared what they learned. The focus of the lessons was on techniques to gain more belief in themselves, in others, in the magic tricks they learned, and in making the impossible possible. The techniques included using body language, eye gaze, storytelling, audience management, giving audiences relatable content, improvisation exercises, and labelling strengths in their classmates. A full list of the specific magic tricks and questions was unfortunately not documented by Abracademy but the ones we managed to confirm from transcribed interviews were an exploding dice trick where a larger dye "exploded" into 6 miniature dice (Magicbox, n.d.) and a trick where the magician

reads the mind of an audience member who thinks of a single colour from a cube with a size different colours on each face (Adams, n.d.).

Measures were given before the first magic class as a baseline, and after the final magic class. Parental consent was obtained prior to the baseline measures and ethical approval was given by a Goldsmiths University ethics committee.

2.3.3 Measures

Social Skills Evaluation

The Matson Evaluation of Social Skills for Youngsters (MESSY) was used to evaluate the social skills of the students (Matson et al., 1983, 2012). The MESSY contains 57 items with a three-factor structure, pertaining to the child's hostile, appropriate/adaptive, and inappropriately overconfident/assertive behaviours. The MESSY items were entered into a Qualtrics survey, which were emailed to teachers before the start of the first class for baseline measures and again after the last class.

Self-Esteem Evaluation

The Self Perception Profile for Children (SPPC) was used to evaluate global and other aspects of self-esteem relevant to the children's age group (Harter, 2012a). The scale contains 36 items with six domains pertaining to scholastic competence, social competence, athletic competence, physical appearance, behavioural conduct, and global self-worth. Students were instructed as per the SPPC's manual on how to fill out the measure, which was administered before the first and after the last magic class.

Qualitative Interviews

Structured interviews were conducted with the children present at the final magic class. Interviews were audio recorded for subsequent analysis. The interviewers asked the same four questions to each child in the magic class individually. The first question was "How do you think the magic club changed the way in which you feel about school?" which was followed up with "Was there anything you really enjoyed?" and "Was there anything you wish was better?". To explore the impact on social skills, the second question was "How do you think the magic club changed your ability to get on with others?", which was followed up with asking "Why?" The third question, aimed at self-esteem changes, was "How do you think the magic club changed the way you feel about yourself?", which was also followed up with "Why?" The fourth and final question asked "What did you think about the magic lessons overall?", which was followed up with "Were there any parts you really enjoyed?" and "Were there any parts you wish were better?" Interviews were conducted by the magic facilitators and in some cases the researchers.

2.3.4 Data Analysis

Self-esteem and Social skills Evaluations

Self-esteem and social skills measures were analysed using SPSS Software V 23.0.0. In order to explore which subscales would be most relevant to learning magic tricks, 2 x 2 mixed ANOVAs were conducted with condition (magic, control) as the between-subject variable and time (before first magic class, after final magic class) as the within-subjects variable for both the SPPC and MESSY measures. Intention to Treat (ITT) analysis was also used (Ranganathan et al., 2016) to ensure conservative results and take into account attrition rates.

Qualitative Interviews

A coding system was developed where two coders read through transcribed audio-recordings of interviews with each individual child. For each of the four questions, a score of a +1 was given if their response clearly showed that the magic had a positive impact in regard to the question (e.g. felt better about school). A score of -1 was given if the response clearly indicated that the magic had no impact or a negative impact (i.e. no change on how they felt about school, or felt worse about themselves). A score of 0 was given if the response was unclear, vague or if the coder was not entirely sure. The final scores for each child were calculated by taking the average between the two coders. Single sample t-tests were used to compare the scores to no change (i.e. value of zero), since there were only data on the magic students due to practical constraints.

2.4 Results

Means and standard deviations for each factor of the MESSY and SPPC are presented in Table 1. Normality for all measures was assessed by absolute values of skewness and kurtosis less than 2 and 7 respectively (Curran et al., 1996) as well as histograms. All values were found to be within acceptable limits.

Table 2.

Means and standard deviations of magic and control group for each factor of the SPPC and MESSY, taken before and after the magic classes.

	Magic				Control			
	Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD
MESSY								
Hostile	65.9	26.7	62.0	24.4	66.0	24.3	62.8	20.9
Appropriate	40.4	10.8	42.0	11.5	39.1	9.9	39.1	9.9
Inappropriately overconfident/assertive.	29.1	10.1	26.9	10.3	29.7	10.3	27.8	10.7
SPPC								
Scholastic competence	2.59	0.79	2.52	0.73	2.56	0.63	2.55	0.68
Social competence	2.94	0.74	2.76	0.84	2.79	0.67	2.72	0.72

Athletic competence	3.02	0.72	2.82	0.77	2.70	0.72	2.83	0.66
Physical Appearance	3.37	0.54	3.43	0.49	3.04	0.72	3.28	0.80
Behavioural conduct	2.72	0.67	2.86	0.77	2.98	0.58	2.90	0.80
Global self worth	2.96	0.47	2.99	0.53	2.78	0.46	2.95	0.45

Matson Evaluation of Social Skills for Youngsters

Teachers completed the MESSY for a total of 44 students for the baseline measurements, which were all included the final ITT analysis. For the final subsequent measure, teachers filled out the MESSY for a total of 31 students. Of those, 6 participant IDs were duplicated and indistinguishable in the final measures and thus treated as missing post data for ITT analysis. Additionally, one participant switched groups midway through and thus treated as missing post data for ITT analysis.

As shown in Table 2, ANOVAs revealed no significant main effects nor interaction effects for any factors of the MESSY.

Table 3.

Main and interaction effects from ANOVA results for each subscale of the MESSY.

	$F_{1,42}$	p	η^2
Hostile			
Group	< .01	.95	< .01
Time	2.31	.136	.05
Interaction	.03	.87	< .01
Adaptive/Appropriate			
Group	.45	.51	.01
Time	1.75	.19	.04
Interaction	1.75	.19	.04
Inappropriately Assertive/Overconfident			
Group	.07	.79	.90
Time	3.9	.06	.09
Interaction	.03	.86	< .01

Self-Perception Profile for Children

A total of 43 students completed the SPPC during baseline measurements, which were all included in the final ITT analysis. Of those, 3 did not complete the final measure.

Additionally, 1 participant who switched experimental groups was treated as missing post data for the ITT analysis.

As summarized in Table 3, ANOVAs revealed no significant main effects nor interaction effects.

Table 4.

Main and interaction effects from ANOVA results for each subscale of the MESSY.

	$F_{1,41}$	p	η^2
Self-Perception Profile for Children			
Global Self-esteem			
Group	0.90	0.35	0.02
Time	1.44	0.24	0.03
Interaction	0.70	0.41	0.02
Scholastic Competence			
Group	< 0.01	0.99	< 0.01
Time	0.24	0.63	< 0.01
Interaction	0.19	0.67	< 0.01
Social Competence			
Group	0.25	0.62	< 0.01
Time	1.35	0.25	0.03
Interaction	0.26	0.62	< 0.01
Athletic Competence			
Group	0.60	0.44	0.02
Time	0.15	0.70	< 0.01
Interaction	2.52	0.12	0.06
Physical Appearance			
Group	1.72	0.20	0.04
Time	2.89	0.10	0.07
Interaction	0.96	0.33	0.02
Behavioural Conduct			
Group	0.62	0.44	0.02
Time	0.10	0.76	< 0.01
Interaction	1.08	0.30	0.03

Qualitative Data coding

A total of 21 students in the magic group took part in the post interviews. The percent agreement between the two coders was 76.2% for the questions on both how students felt about themselves (i.e. self-esteem) and how they felt about school. The

agreement was 90.5% for the questions on both how they got along with others (i.e. social skills) and their overall opinion of the magic lessons.

Results from single sample t-tests comparing the scores to no change (i.e. scores of zero) showed significant increases for overall opinion of magic club (M = 0.91, SD = 0.26), $t(20)$ = 16.2, p < .001, d = 0.95, and self-esteem (M = 0.60, SD = 0.62), $t(20)$ = 4.37, p < .001, d = 3.54. No significant differences were found for their opinion of school (M = 0.26, SD = 0.72), $t(20)$ = 1.67, p = 0.11, nor social skills (M= 0.29, SD = 0.89), $t(20)$ = 1.47, p = 0.16.

2.5 Discussion

The aim of the study was to explore how a school-based magical arts program affects social skills and age relevant domains of self-esteem for primary school children with mild confidence and inhibition concerns (based on teachers' reports). A weekly magic class was incorporated into the school and delivered to half of these students over the course of 8 weeks. Repeated measure analyses showed no significant main effects nor interaction in social skills and self-esteem measures. However, statistical analyses from qualitative interviews indicated that students (1) felt better about themselves as a result of the magic lessons and (2) had a positive opinion of the magic classes.

The qualitative interviews were most revealing of the children's experiences. Consistent with observations from prior studies (Ezell & Klein-Ezell, 2003; Kwong & Cullen, 2007; Levin, 2006; K. Spencer, 2012), the magic lessons appeared to have a positive impact on students self-reported self-esteem, much of which appeared in the question asking about their opinion of school before they were even asked about self-esteem. Anecdotes from the children predominantly came from learning a new skill, reflecting James' (1892) theory stating that self-esteem results from progress in domains valued by the individual. Example quotes from interviews include "it

makes me feel like I have a talent" and " [I] feel more happy because I get to miss lessons and learn new magic tricks". Other comments centred around positive affect like having fun or making the child happy. Example quotes are "…because, magic makes me feel happy a bit", and "I think cause I used to be, like, a little bit worried of doing magic because I would never do it. But now, like, that I'm getting taught magic, I feel like really happy about it." Two children misunderstood the question, answering how it physically made them feel better, as one child mentioned "my legs get achy when sitting down", and another commented "In class, like, you don't really get to move around and you feel a bit stuck. But in magic club, you get to move around." Lastly, three children's responses implied that they began incorporating "magician" into their identity as evidenced by them saying "…I'm a young magician now", "it's making me want to actually be a magician when I'm older", and "…but I want to be a magician and when I showed my friend one of the magic tricks, her face was like surprised because she's never seen it before". The latter quote also reflects Cooley's (1902) model where self-esteem arises from opinions of others. Overall, the results from the coding system appeared to capture these positive impacts on the children's self-esteem, especially since the older end of our age range is typically a time when self-esteem decreases as a result of more realistic self-evaluations (Jacobs et al., 2002).

It is unclear whether these experiences will become a memorable experience, salient in their autobiographical memory and personal narratives for the long term since the study was not longitudinal. However, it is noteworthy that four students talked about how magic was interesting or less boring in their responses to how the class made them felt about school. Since this theme of interest emerged despite never being directly asked, this may suggest that curiosity plays an important role, which reflects the common theme of eliciting curiosity in prior studies on magic (Bagienski & Kuhn, 2019). Other responses to how the magic class affected their perception of school included missing class, ambiguous statements of making school more "magical", and giving them a valuable new skill.

The coding schema for social skills did not reveal any statistically significant results, suggesting that the effect (if any) is smaller than for self-esteem. Some children clearly said it had no effect, whereas others elaborated on how the magic club improved their social relationships. These benefits involved allowing them to make new friends, spending time with existing friends, and, most frequently: performing tricks for others. Representative examples include "I made new friends in magic club", "because I spent more time with them. And I got more time to understand them", and "Yes, because well, when I show people, they, like, get impressed and they, like, start being friendly & nice." The contrast between responses may indicate that individual differences moderate the effect, such as more extraverted children gaining more benefit from the magic tricks whereas introverts may feel uncomfortable performing.

As for their overall opinion of the magic program, the responses were extremely positive. Responses to what parts they enjoyed most encompassed a wide range of reasons. Reasons consisted of watching the magic performances, exciting moments of insight when discovering secrets, easily learning tricks, other exercises during magic class, the uniqueness of the magic, specific tricks that were their favourite, performing the magic, fun and humour, meeting other people, and in one case: coming up with more ideas. Since this was the final question asked, children may have been led to give socially desirable responses as asking questions can increase likeability (Huang et al., 2017), especially since magic instructors did most of the interviewing. Additionally, socially desirable responses may have been enhanced by the direct presence of interviewers (Krumpal, 2013). On the other hand, the questions did not contain any sensitive, uncomfortable content that would discourage honest answers and some children said they wanted magic classes to last longer. So, while the 90% approval score may likely be an overestimate, we believe it is unlikely to be an excessive overestimate.

Thus, these interview results justify the merit in furthering research on how magic can be implemented in the teaching environment, especially by addressing the limitations of the

established self-esteem and social skills measures that were administered before and after the magic program. Although this was the first experiment in the magic and wellbeing literature to utilise a control group, the most evident limitation is that the study may lack of statistical power with its sample sizes of 43 and 44 (less than 25 per condition) for the MESSY and SPPC respectively, which provides limited insights. While power calculations were not possible due to the scarcity of research, Marszalek et al. (2011) argue the need for larger sample sizes in psychology, especially for applied settings like the present experiment. This lends stronger support that our sample size is underpowered. Although more descriptive rather than prescriptive, a post-hoc power calculation was conducted using G*Power 3 (Faul et al., 2007) to test the difference between two independent group means using a two-tailed test,a small effect size (d= .2), and an alpha of .05. Result showed that a total sample of 44 participants with two equal sized groups of n= 22 would only achieve a power of .10.

The younger end of the sample may have also had overly positive self-evaluations to begin with, as this is characteristic of younger children (Harter, 2012b), thus limiting the range for self-esteem increases. Furthermore, since these were typical children (i.e. not diagnosed learning nor other disabilities), we would expect effect sizes to be smaller as there is less room to improve. A similar argument has been proposed for how positive psychology interventions tend to have smaller, yet significant, effect sizes (White et al., 2019). Another consideration is the potential for survey fatigue of the teachers completing the social skills measures, since they completed 57 questions for each student amidst their demanding schedules, which likely yielded discomfort and perhaps less positive responses. Thus, care should also be taken in future studies to minimize discrepancies between child and teacher reported measures. On the other hand, social skills are more easily observed (i.e. helping others, name calling) whereas self-esteem is a more internalized evaluation that may be more accurate as a self-report. Thus, finding an appropriate balance is important.

In summary, this work can be viewed as a preliminary feasibility study. Future research directions should first and foremost aim for attempts with sufficiently powered samples to gain insight into whether learning magic affects certain domains of self-esteem and whether it acts on a more global level. Consideration should also be given to the type of samples employed, such as degree of disability and developmental stage of children in defining their sense of self-worth. For example, experiments in developmentally healthy children could help clarify whether magic is more useful for disadvantaged children or has preventative benefits for others as well. Results from qualitative analyses suggest the latter for self-esteem, since this sample contained children with very mild developmental concerns instead of more severe learning disabilities. The impact of social skill development is another area of interest, which may be moderated by individual differences in personality, such as extraversion or social curiosity. Likewise, individual differences in the ways people can be curious may moderate the impact, as suggested by the subset of students who mentioned how interesting the magic was. Ultimately, comparison to other arts-based interventions would also be worthwhile to determine where magic-based programs fit in best. A particular focus should be on the unique notion of how magic focuses on creating impossible moments, thus giving a sense of achieving the impossible. In gaining a deeper understanding, such research may ultimately help refine ways of adding more meaningful magic to future educational systems.

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Chapter 3: Supporting the psychological health of our first-year students:
A community magic workshop for adapting to university

Abstract:

The arts have long been intertwined with wellbeing and empirical attention is shifting back toward the wellbeing value of the arts. One art that has been applied in educational contexts but received limited empirical attention is that of achieving the impossible, namely, the art of performing magic. While research is young, reviews on the wellbeing-value of magic have revealed theoretical frameworks suggesting its potential to enhance self-processes and social aspects. These aspects are especially important for university students to have a psychologically healthy transition to university life since this transitional period involves integrating one's adult identity, which becomes challenging to one's self-esteem. Thus, the present study investigated how community magic workshops affect self-esteem, wellbeing, closeness, and sense of belonging for first-year university students in London. Students were allocated to either magic workshops where they learned magic tricks or mindfulness workshops during their first university term. Measures were taken at baseline, post-intervention, and a one-month follow-up. Both groups improved on all measures but students in magic workshops perceived greater benefits than the mindfulness group. Results provide preliminary evidence for

using magic-based workshops as an appealing, preventative intervention that enhances the

college experience for first-year students.[4]

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[4] This chapter has been submitted and accepted for publication. See:
   Bagienski, S. E., Kuhn, G. (in press). Supporting the psychological health of our first-year students: An arts-based community magic workshop for adapting to university. *Psychology of Consciousness.*

3.1 Introduction

Throughout history, the arts have been a powerful, precious, and prevalent part of society. Not only do we see this in music, museums, and movies, but also in the artistic design of cities, landscapes, and everyday offices. Furthermore, the value of the arts is evident from their impact on scientific success (Root-Bernstein et al., 2008) as well as their impact on the economy, health, society, and education (Mowlah et al., 2014). The arts and wellbeing have long been intertwined, with scientific interest in their link growing during the 18th and 19th centuries, but as scientific advances accelerated emphasis on biomedical models began to outpace other aspects of care, especially the wellbeing value of the arts (Fancourt & Finn, 2019, Chapter 1)

However, with the advent of the biopsychosocial model of health in the past century (Engel, 1977), attention shifted back toward the wellbeing-value of arts, with scientific interest following. This wellbeing-value of the arts has been shown across all three levels of the model: biological, psychological, and social. For example, psychological benefits include reducing stress (Backos & Pagon, 1999; Dokter, 1998, p. 460; Webb, 1991), regulating emotions (Hillman, 1960, p. 340; Juslin & Sloboda, 2011, p. 1389), and enhancing self-esteem (Franklin, 1992; Hartz & Thick, 2005). Additionally, social benefits of the arts encompass increased social support (Cohen et al., 2006; Crawford et al., 2013; Murrock & Madigan, 2008) and fostering intergroup social cohesion (Lee, 2013).

One art that has been scientifically neglected regarding wellbeing is the art of creating the impossible: the performance art of magic. In fact, this oversight extends to whether magic qualifies as an art, which spurred Congress to pass a bill stating that magic is a rare and valuable art form (H.Res.642, 2016). Meanwhile, the scientific study of magic has increased greatly over the past decade (Kuhn, 2019; Kuhn et al., 2008; Rensink & Kuhn, 2015a, 2015b).

Only recently has this empirical interest been applied to areas such as wellbeing and education (Bagienski & Kuhn, 2019, 2020; Lam et al., 2017; Wiseman & Watt, 2018).

Examples of the expansion to wellbeing include curiosity and its use as a distraction therapy (Labrocca & Piacentini, 2015; Peretz & Gluck, 2005; Pravder & Elkin, 2019; Vagnoli et al., 2005), an engagement tool for physical therapy (Green et al., 2013; Harte & Spencer, 2014), and a means of enhancing self-esteem and positive self-emotions, such as pride (Danek et al., 2014; Ezell & Klein-Ezell, 2003). However, much of the theoretical basis is still speculative and these few empirical studies that do exist often lack empirical rigour. For example, studies that involve learning magic often fail to clarify whether benefits emerge from the actual performing or from factors embedded within the learning of magic (e.g., watching magic, discovering secrets, sharing secrets). Many study designs also preclude the possibility of determining whether benefits arise from magic or from simply learning a new skill (Bagienski & Kuhn, 2019, 2020). Nevertheless, the preliminary findings appear promising, most notably in suggesting that learning to perform magic may improve social skills and self-esteem (Bagienski & Kuhn, 2019).

Regarding self-esteem, prior experiments have typically involved younger participants learning and performing magic, especially in populations with low self-esteem. Part of the theoretical rationale is that magic increases engagement in interventions (Bagienski & Kuhn, 2019) via the intense curiosity it evokes (Leddington, 2016). Attempts to enhance self-esteem through magic also typically involve the notion of developing an impressive skill that others cannot perform (Frith & Walker, 1983), which speaks to two common theoretical models for the development of self-esteem. First is the model put forth by James (1892) which suggests that self-esteem arises when one's perceived success in valued domains meets the expectation of one's self in that domain. Learning magic may fit these criteria, firstly, because magical content is valued by both children and adults, as evidenced by experiments showing that tricks presented with a magical causation are more interesting to explore (Subbotsky, 2010).

Furthermore, many are driven to figure out how a trick works, which may suggest that learning the secret is valued, and this aligns with research on how people place greater value on things (e.g. secret knowledge) that are scarce (Cialdini, 2007). Secondly, the perceived success could be ensured by 1) choosing simple, effective magic tricks, and 2) performing them for naïve spectators to gain social proof of the success. People also tend to set aspirations and expectations of themselves in the realm of possibility, and hence their expectations of achieving the 'impossible' would be low for magic. Thus, at a certain imaginary level, learning to perform the impossible would necessarily *exceed* one's expectations. At a more realistic level, this sense of performing the impossible becomes somewhat 'real' because the social reactions to magic tricks often imply that the impossible did indeed become possible. Furthermore, since magic evokes curiosity (Bagienski & Kuhn, 2019; Leddington, 2016), these successes may create an especially salient autobiographical memory that enters one's personal narrative. Since autobiographical memory is pivotal for developing self-continuity (Robyn & Haden, 2003), this salient experience of learning magic could be particularly memorable and useful in forming one's identify via favourable self-evaluations.

The social reactions to magic would also enhance self-esteem within Cooley's (1902) 'looking-glass' model of self-esteem, since Cooley suggests that the self is created from opinions of significant others who act as a social mirror. This idea of a social mirror is also useful in explaining why better social skills emerge in magic studies only when learning to perform magic, rather than watching magic or discovering its secrets (Bagienski & Kuhn, 2019). One rationale is that reactions to magic mimic the interested, enthusiastic, active-constructive responses that act as social validation and form the basis of positive relationships (Bagienski & Kuhn, 2019; Gable et al., 2004, 2006). Another theory is based on magic being the only art that deliberately uses speech and social cues for misdirection (Scott et al., 2018) and is thus a natural fit for improving social skills. Cooley's model has been further expanded to suggest that

'significant others' can vary throughout life, such as the more judgemental 'imaginary audience' during adolescence (Elkind, 1967) and the 'generalized other' for older ages (Harter, 2006; Mead, 1934), which may suggest that learning magic to enhance self-esteem is better suited for adults. This more general approval from the public peer domain is also more critical to self-esteem (Harter, 1990, 2006) than approval from close friends and loved who offer more stable, unconditional approval of one's self worth, whereas approval in the public domain is more fragile and must be earned. For this same reason, self-esteem interventions may be most fruitful in contexts where people do not know each other well.

One such context where increasing (and maintaining) self-esteem would be desirable is the period of emerging adulthood. Emerging adulthood is characterized by a period of exploration in domains relevant to adulthood such as one's career, relationships, and political, moral, or religious beliefs due to uncertainty, doubt and instability in these areas (Erikson, 1968; Nelson & Barry, 2005). As such, it is also one of highest risk periods for the onset of depression (Arnett, 2000; Nelson & Barry, 2005), especially for those making the transition to college, since it can be exacerbated by moving away from home to a more challenging academic environment and by factors like the scattering of friends, separation from family, doubts about competence, and a heightened awareness of the increasing urgency to make adult decisions (Nelson & Barry, 2005; Shulman et al., 2005).

The main developmental task at this stage, according to theorists, is identity achievement. This is achieved after adequately exploring temporary roles and making commitments in adult domains, particularly in regards to one's vocation (Erikson, 1968; Schwartz, 2001), that integrate into a coherent and meaningful identity.   Thus, Erikson (1968) suggested an exploration and commitment model that was later expanded by Marcia (1980) clarifying four identity statuses based on combinations of high or low levels of exploration and commitment. At the end of adolescence nearly 50% of teenagers are estimated to be in a

period of low exploration (Cote, 1996) and thus interventions for first-year college students should encourage exploratory behaviour. Drawing upon broaden-and-build theory (Fredrickson, 2004), such exploratory behaviours could be encouraged through interventions that include positive emotions like curiosity, such as playful workshops that include magic performances. Playful magic lessons may also help facilitate the exploration and integration of identities by giving students a new, previously undefined role of 'magician' where they can comfortably explore and integrate conflicts in their possible future selves; another key task for identity achievement (Markus & Nurius, 1986).

A previous study has looked at self-esteem during the first college term. Researchers found that of those whose self-esteem increased, were those who gained social support at college, while those who had failed to gain social support and make new social connections decreased in self-esteem (Harter, 1990, p. 166). Thus, social support is very important and as noted earlier, prior research highlights that learning to perform magic may have social benefits (Bagienski & Kuhn, 2019). Another benefit of utilizing magic is that it implies a form of entertainment instead of a therapy or mental health service, which means magic can be an appealing preventative measure for all students, regardless of whether they need psychological help.

In the current study, we set out to examine whether a novel magic-themed community workshop would enhance the wellbeing of first-year students during their first term at the university. Specifically, we focused on self-esteem and social aspects of wellbeing since prior work with magic has shown some promise in these areas. To improve and build upon prior work, we utilized a comparable control group that also practiced an activity (i.e. mindfulness). The social aspects we were interested in were how close students felt to each other and their sense of community within the psychology department. We hypothesized both to be greater for the magic group due to the more interactive performance nature, especially when social

components of mindfulness training are minimized (i.e. no loving-kindness meditations). Since mindfulness can heighten an awareness of both positive and negative emotions through emotional regulation (Hill & Updegraff, 2012), we also hypothesized any self-esteem increases to be smaller in magnitude compared to the magic group. For this reason, we also expected magic to perform better on wellbeing measures of depression, anxiety and stress, especially when minimizing social components of the mindfulness, due to the strong links between social relationships and wellbeing (Lyubomirsky et al., 2005). Finally, we hypothesized that self-reported perceived measures of closeness, community belonging, self-esteem and wellbeing to follow identical patterns of magic outperforming the mindfulness workshops.

3.2 Materials and methods

3.2.1 Participants

Participants were first-year undergraduate psychology students at a university in United Kingdom. This first-year cohort consisted of 243 students. Of these, 133 students completed the baseline questionnaires during the first workshop and 85 completed all three measures. As expected from our university's typical demographic (Goldsmiths University of London, 2018), the sample was heavily skewed toward females (69 female vs 16 male). However, as argued by Fivush and Buckner (2003), gender differences for self-processes are less relevant during this period because college students are surrounded by similar others, of similar ages, with similar goals. Thus, the salient focus on things like academic achievement, concerns over career choice, or professional aspirations tend to overshadow gender differences, since these domains are relevant to both males and females. Chi-square tests confirmed that proportions of males and females were equally distributed across treatment groups, $\chi2$ (2, N = 85) = .72, p = .422. In testing whether ages of participants who completed the workshops were equal, the homogeneity of variance assumption was not met, so independent sample t-tests assumed

unequal variances and confirmed that ages did not differ significantly between groups, $t(69.2) =$ 1.16, $p = .242$.

The students' perceived effects of workshops were also measured after the intervention and during the follow-up. For this sample, participants were included in the analysis, even if no baseline data was available that matched up with the participant ID (or lack of ID), provided they completed at least one workshop. Thus, the sample for the perceived effects was larger with a total of 100 students in the first post questionnaire (16 male, 67 female, and 17 other or unknown due to not providing participant ID in the survey) and 87 students in the final follow-up questionnaire (17 male, 70 female).

3.2.2 Procedure

Students were randomly allocated by the university's timetabling team into one of six timetabling streams. Of these six streams, three were for the magic condition, and three were for a mindfulness control condition. All magic streams were given the same series of three workshops, and likewise for mindfulness streams. Workshops took place during the 9th, 11th and 13th weeks of the autumn term and lasted 1.5 to two hours each. For each week, the same mindfulness or magic workshop was delivered twice on the Tuesday of the week and once more on Friday for different groups of students. Each magic workshop ran simultaneously to a mindfulness workshop scheduled in parallel sessions, in different classrooms (See Figure 1).

Magic workshops

Mindfulness workshops

Session 1
Baseline measures taken: • Self-esteem • Closeness • Community Belonging • Depression, Anxiety, Stress
First Magic Workshop (1.5 hours)

Session 1
Baseline measures taken: • Self-esteem • Closeness • Community Belonging • Depression, Anxiety, Stress
First Mindfulness Workshop (1.5 hours)

2 weeks

2 weeks

Session 2
Second Magic Workshop (2 hours)

Session 2
Second Mindfulness Workshop (2 hours)

2 weeks

2 weeks

Session 3
Third Magic Workshop (1.5 hours)
Post-measures taken: • Self-esteem • Closeness • Community Belonging • Depression, Anxiety, Stress

Session 3
Third Mindfulness Workshop (1.5 hours)
Post-measures taken: • Self-esteem • Closeness • Community Belonging • Depression, Anxiety, Stress

1 month

1 month

Follow-Up
Follow-up measures taken: • Self-esteem • Closeness • Community Belonging • Depression, Anxiety, Stress

Follow-Up
Follow-up measures taken: • Self-esteem • Closeness • Community Belonging • Depression, Anxiety, Stress

Figure 1. Summary of workshop protocols and measures. All magic and mindfulness sessions and measures occurred simultaneously in parallel sessions. The follow-up sessions were e-mailed to participants.

To disseminate information about the workshops, all students had a module entitled 'Wellbeing Workshops' placed in their online timetable and were made aware of it during their freshman welcome week, via emails from the first-year coordinator, and reminders at tutorial sessions. By completing measurements at all three timepoints, students could receive 15 research credits that would contribute to their grade for their research methods module. All surveys were delivered in Qualtrics software that students completed on their personal phones, tablets, or laptops. Participation was optional since students could alternatively decide to participate in other studies.

The overall structure of both workshops typically began with a 'check-in' to discuss workshop content or their experience of applying it, followed by exercises to help deliver content, discussions of the experience, and ended with a recap of the main take-aways. amplify the effectiveness, 'homework' challenges were also given in both workshops that students could do outside of workshops. More specific details of the content and exercises for each workshop are outlined below.

3.2.3 Mindfulness workshops

Mindfulness workshops were chosen as an active control group to account for potential confounds from learning a new skill as well as ethical considerations. Since we were interested in social and communal aspects of magic, these were minimized for mindfulness workshops by intentionally avoiding mindfulness activities, such as loving-kindness meditations.

The first of the three workshops focused on giving students a definition of mindfulness, explaining awareness, presence and nonjudgement, and encouraged students to pay attention to bodily sensations. Exercises included squeezing one's fist with and without paying attention to one's breath, and a 10-minute guided body scan meditation. As home practice, students were encouraged to pay mindful attention to an everyday task and use the free Insight Timer

app for guided meditations.

The second workshop focused on the link between bodily sensations and emotions, as well as how this is relevant in everyday life. A personal story was given by the facilitator on how noticing one's emotion helped him to react appropriately to a stressful situation and exercises included a 15-minute body scan meditation, a 10-minute mindfulness of breath meditation, and a mindful movement exercise.

The third workshop focused on equanimity, the negative impact that lacking mindful awareness can have when responding to unpleasant events, and the positive impact it can have on enjoying life more. Exercises included a mindful movement exercise, a 15-minute body scan meditation, and a mindful eating exercise with cake or chocolates.

3.2.4 Magic workshops

Magic workshops were delivered by Abracademy, a company that blends learning design and facilitation techniques with the teaching of magic tricks (*Abracademy*, n.d.). The first magic workshop focused on the concept of belief in one's self, in others, and in making the 'impossible' possible. After a short magic performance, there was a brief check-in for introductions, followed by asking students about the values they would like to have during the workshops. A second magic performance about the magician believing in himself was then performed, which transitioned into a third performance where a student volunteer used 'magical powers' to create a glowing ball of light that the magician could vanish, re-appear, and toss around. This last trick was taught to all students, who practiced handling the light with both the whole group and in pairs. After mastering this trick, students were taught how belief can be conveyed through body language and a magic pen trick was taught to practice these body language skills. The homework challenge given to students was to watch themselves perform the trick in a mirror, video, or method of their choosing and post a video of their solo performance in a WhatsApp

group. They were also given a customized website with resources to review what they learned.

The second workshop focused on connecting with one's audience and other people through story and relatable content. It started with a magic performance, which was used as a springboard for discussion on ways the magician may have made his performance more believable. The discussion was facilitated to include body language as well as the use of relatable stories to connect with the audience. The importance of improvisation was also introduced, and students engaged in an improv exercise in small groups.   Next, half of the class learned one trick and the remaining half learned a different trick. After practicing, each student then performed for a student who did not learn the same trick. To conclude, the students formed groups based on an emotion they wanted to convey through their magic. After deciding and practicing their presentation in groups, each group then performed in front of the entire class. The homework challenge was to perform for three people, optionally record it, and request feedback on what went well and how to improve the performance.

The final magic workshop focused on helping students discover their 'magical' self by exploring their strengths. The first magic performance was used as an example of how performing magic was a strength of the performer. Other exercises included sharing a time at their best in pairs before discussing strengths they saw in their partner's story, and an interactive magic trick where all students received playing cards and alternated chants of 'I love me!' with 'Not so much'. All students then learned one final magic trick and the workshop culminated in an activity where students wrote strengths they saw in others on sticky notes, which were stuck on the back of the corresponding person as music played.

3.2.5 Measures

The variables of interest were students' self-esteem, psychological closeness, belongingness, and general wellbeing. The scales used for pre- and post-measures were administered

immediately before the first workshop began, immediately after the final workshop, and at the 1-month follow up.   The perceived effects were asked immediately after the final workshop and once more at a 1-month follow up. All items were within the same questionnaire, created with Qualtrics web software.

Self-esteem

Self-esteem was measured using the Self-Perception Profile for College Students (Neeman & Harter, 1986). Seven of the 13 domains were chosen based on a hypothesized relevance to magic. The chosen domains and reliabilities as assessed by Cronbach's alpha during baseline were as follows: Creativity = 0.84, Intellectual Ability = 0.74, Scholastic Competence = 0.70, Social Acceptance = 0.79, Close Friendships = 0.75, Finding Humor in One's Life = 0.82, and Global Self-worth = 0.88. Each item presents descriptions of two types of students on opposite ends of a spectrum and respondents are asked to rate the degree to which student he or she is most like. Each item score ranges from one to four, with higher scores indicating higher self-esteem within that domain. All domains contain four items each except for Global Self-worth, which contains six.

The perceived effect of Self-esteem was measured quantitatively by asking participants 'How do you think the workshops affected the way you feel about yourself (i.e. self-esteem)?' on a 7 point scale from 'Much worse about myself' to 'Much better about myself'. This was followed with the qualitative, open ended question: 'If you feel the workshops affected the way you feel about yourself (i.e. self-esteem), please describe how and why?'

Closeness

Closeness was measured via the Inclusion of Other in Self (IOS) scale (Aron et al., 1992), which contains a single item with 7 paired circles depicting different degrees of overlap between two overlapping circles labelled 'Self' and 'Other'. The item instructed participants to 'Please select

the picture that best describes your current relationship with other [University name] psychology students.' The original development demonstrated good reliability (alternate form reliability, α = .87 to .95; and test-retest reliability of .85 [Aron et al., 1992]).

The perceived effect of closeness was measured quantitatively by asking participants 'To what extent do you feel the workshops have affected how close you feel to other [University name] psychology students?' on a 7-point scale from 'Much less close' to 'Much closer'. This was followed by the qualitative, open ended question: 'If you feel the workshops affected the closeness of your friendships and relationships with other students, please describe how and why?'

Community Belonging

Community belonging was measured via the perceived cohesion scale (Bollen & Hoyle, 1990, p. 485), with the term "[University name]'s psychology" as the referent community. Reliability as assessed by Cronbach alpha during baseline was .93.

The perceived effect of belonging was measured by asking participants 'How do you feel the workshops affected your sense of belonging in [University name] psychology?' on a 7-point scale from 'Belong much less' to 'Belong much more'. This was followed with the qualitative, open ended question: 'If you feel the workshops affected your sense of belonging, please describe how and why?'

Wellbeing

Other aspects of wellbeing were measured by first using a general life happiness measure via the question 'Overall, how happy are you with your life as a whole these days?' on a 7-point scale. The second measure of wellbeing was Henry & Crawford's (2005) short form of the Depression, Anxiety, and Stress Scale (DASS-21). Reliability as assessed by Cronbach alpha during baseline for subscales was as follows: Depression = .86, Anxiety = .81, Stress = .85.

The perceived effect of wellbeing was measured by asking participants 'How do you feel the workshops affected your general sense of wellbeing at [University name]?' on a 7-point scale from 'Much lower' to 'Much higher'. This was followed by the qualitative, open ended question: 'If you feel the workshops affected your general sense of wellbeing, please describe how and why?'

3.2.6 Data Analysis

To determine the effectiveness of the intervention for self-esteem, closeness, belonging and general wellbeing, thirteen 2 x 3 mixed ANOVAs with condition (magic, control) as the between subjects variable and time (baseline, post, and one month follow-up) as the within subjects variable were conducted for each scale or subscale. Last observation carried forward Intention to Treat (ITT) analysis was also used (Ranganathan et al., 2016) to ensure conservative results and take into account attrition rates.

To determine differences between groups on perceived effectiveness of the workshops on self-esteem, closeness, belonging, and wellbeing, a series of t-tests were conducted on scores at both the post measure and the one-month follow-up.

3.3 Results

A summary of the mean scores and standard deviations for the scales is presented in Table 1 and the perceived measures are presented in Table 2. The analysis for perceived effects tested the differences between the groups on self-reported, perceived effectiveness of the workshops on four domains: self-esteem, closeness with other students, belongingness at the university, and general wellbeing. The ANOVA analyses tested whether these four domains improved over the course of the workshops and whether it sustained at a one-month follow-up.

A total of 133 students completed the baseline measures. Of these, 89 completed the post measure, and 85 completed the follow-up measure (mean age = 19.16, SD = 1.74). Of

those who completed the follow-up measures, two did not complete the post measure. Thus, as per last observation carried forward ITT analysis, the most recent score was carried forward and treated as 'no change'.

Some students participated in the workshops but were missing baseline data. For these students, they were included in analyses only for perceived measures, provided they attended at least one workshop. This resulted in a total sample size of N = 100 for the perceived post measures, and N = 87 for the one-month follow-up measure.

Table 1 *Means and standard deviations for magic and mindfulness groups at baseline, post measure, and follow up measure.*

| | Magic | | | | | | Mindfulness (control) | | | | | |
| | Pre | | Post | | Follow Up | | Pre | | Post | | Follow Up | |
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Self-Perception Profile for College Students												
Scholastic Competence	2.20	0.61	2.42	0.62	2.36	0.58	2.32	0.55	2.48	0.61	2.45	0.5
Social Acceptance	2.53	0.74	2.69	0.74	2.71	0.70	2.65	0.68	2.72	0.68	2.75	0.6
Close Friendships	2.52	0.73	2.72	0.78	2.65	0.77	2.76	0.72	2.94	0.68	2.91	0.7
Intellectual Ability	2.31	0.61	2.46	0.61	2.48	0.63	2.32	0.71	2.51	0.71	2.54	0.6
Finding Humor in One's Life	3.09	0.66	3.14	0.72	3.14	0.70	3.17	0.66	3.26	0.70	3.32	0.5
Creativity	2.24	0.69	2.38	0.66	2.43	0.66	2.33	0.68	2.48	0.66	2.48	0.7
Global Self-worth	2.66	0.70	2.80	0.64	2.77	0.69	2.67	0.72	2.73	0.71	2.74	0.7
Inclusion of Other in Self Scale (closeness)	5.23	1.17	5.05	1.47	5.15	1.43	4.90	1.32	5.16	1.49	5.16	1.4
Perceived Cohesion Instrument (belonging)	2.79	1.22	3.33	1.62	3.32	1.56	3.01	1.37	3.42	1.49	3.49	1.5
Life Happiness	5.14	2.24	5.68	2.46	5.63	2.40	5.43	2.01	6.22	2.17	6.48	1.9
DASS-21												
Depression	12.30	9.68	10.61	9.94	11.21	10.93	12.30	9.36	10.60	9.05	10.24	8.8
Anxiety	14.58	10.11	12.24	9.18	11.73	10.29	14.03	9.76	13.16	8.92	11.16	9.1
Stress	16.09	9.96	14.00	9.24	14.76	10.53	17.94	9.67	16.21	10.82	15.07	10.

Table 2 *Means and standard deviations for perceived scores of magic and mindfulness groups measured at the end of the intervention and 1-month follow-up.*

| | Magic (n = 51, 47) | | | | Mindfulness (n = 49, 40) | | | |
| | Post | | Follow Up | | Post | | Follow Up | |
	M	SD	M	SD	M	SD	M	SD
Self-Esteem	5.61	1.23	5.06	1.05	4.71	1.06	4.55	0.96
Closeness	5.73	1.00	5.43	1.12	4.69	1.00	4.80	1.02
Community Belonging	5.47	1.16	5.09	1.06	4.65	0.93	4.60	0.71
Wellbeing	5.33	1.16	4.89	0.96	4.71	0.98	4.50	0.75

3.3.1 Self-Esteem

Self-Perception Profile for College Students

There was a main effect of time, $^*F(1,131) = 5.79$, $p < .01$, $\eta^2 = 0.04$, showing increased global self-esteem over the course of the interventions. There were also main effects of time showing increased self-esteem in the subscales of scholastic competence, $F(1,131) = 13.45$, $p < .001$, $\eta^2 = .09$; social acceptance, $^*F(1,131) = 8.20$, $p < .005$, $\eta^2 = 0.06$; close friendship, $F(1,131) = 12.19$, $p < .001$, $\eta^2 = 0.09$; intellectual ability, $^*F(1,131) = 15.58$, $p < .001$, $\eta^2 = 0.11$; finding humour in one's life, $^*F(1, 131) = 3.70$, $p < .05$, $\eta^2 = 0.03$; and creativity, $F(1,131)= 10.68$, $p < .001$, $\eta^2 = .08$. There were no significant main effects of condition nor any significant interaction effects for all pre and post measures of self-esteem.

Perceived Self-esteem

For the perceived effects on self-esteem during the post measure, results indicated that the magic group perceived significantly higher improvements in how they felt about themselves (due to the workshops) than the mindfulness group did, with a large effect size, $t(98) = 3.88$, $p < .001$, $d = 0.78$. For the final follow-up survey, the same trend was found with a smaller, yet still significant, medium effect size, $t(85) = 2.37$, $p < .05$, $d = 0.51$. Means for both groups were above the midpoint (i.e. value of 4) at all timepoints, which suggests that both interventions were perceived as beneficial for self-esteem.

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[*] Greenhouse Geisner correction applied to analysis in cases where Mauchly's test of sphericity was significant for uncorrected model and are indicated by asterisks (*).

3.3.2 Closeness

Inclusion of Other in the Self

There was a main effect of time, $F(1,131) = 15.85$, $p < .001$, $\eta^2 = 0.11$ showing an increased sense of closeness with other psychology students over the course of the interventions. There were no significant main effects of condition nor any significant interactions.

Perceived Closeness

For the perceived effects of closeness during the post measure, results indicated that the magic group perceived significantly higher improvements in how close they felt with other students (due to the workshops) than the mindfulness group did, with a large effect size, $t(98) = 5.14$, p < .001, $d = 1.0$. For the follow-up measure, the same trend was found with a smaller, yet still significant, medium effect size, $t(85) = 2.37$, $p < .01$, $d = 0.59$. Means for both groups were above the midpoint (i.e. value of 4) at all timepoints, which suggests that both interventions were perceived as beneficial for closeness.

3.3.4 Belonging

Perceived Cohesion Scale

There was a significant main effect of time, $*F(1,131) = 18.66$, $p < .001$, $\eta^2 = 0.13$, showing an increased sense of belonging to the psychology community, over the course of the intervention. There were no significant main effects of condition nor any significant interactions.

Perceived Belonging

For the perceived effects of belonging during the post measure, results indicated that the magic group perceived significantly better improvements in their sense of belonging to psychology (due to the workshops) than the mindfulness group did, with a large effect size, $t(98) = 3.90$, $p < .001$, $d = 0.78$. For the final follow-up survey, the same trend was found with a smaller, yet still significant, medium effect size, $t(85) = 2.436$, $p < .05$, $d = 0.54$. Means for both groups were

above the midpoint (i.e. value of 4) at all timepoints, which suggests that both interventions were perceived as beneficial for community belonging.

3.3.5 General Wellbeing

DASS-21 and life happiness

There were no significant main effects nor interactions for the life happiness measure. There were, however, significant main effects in the DASS-21 for decreases in the subscales of depression, $^*F(1,131) = 5.53$, $p < .005$, $\eta^2 = 0.04$; anxiety, $F(1,131) = 11.70$, $p < .001$, $\eta^2 = 0.08$; and stress, $^*F(1,131) = 7.48$, $p < .001$, $\eta^2 = 0.05$. There were no significant main effects of condition nor interactions for any subscales of the DASS-21.

Perceived Wellbeing

For the perceived effects of wellbeing during the post measure, results indicated that the magic group perceived significantly higher improvements in their general sense of wellbeing (due to the workshops) than the mindfulness group did, with a medium effect size, $t(98) = 2.88$, $p < .005$, $d = 0.58$. For the final follow-up survey, the same trend was found with a smaller, yet still significant, medium effect size, $t(85) = 2.10$, $p < .05$, $d = 0.45$. Means for both groups were above the midpoint (i.e. value of 4) at all timepoints, which suggests that both interventions were perceived as beneficial for general wellbeing.

3.4 Discussion

Undergraduate students during their first term of college took part in either magic or mindfulness workshops. To examine the impact of the workshops on the students' self-esteem, closeness, community belonging, and general wellbeing, measures were taken before the workshops, immediately afterwards, and at a one-month follow-up. Overall, improvements were found for both workshops in all measures across time and thus appear to be beneficial. Contrary to our

hypothesis, however, the pre- and post-measures showed no significant between group differences. On the other hand, students reported larger perceived benefits for the magic workshops, compared to mindfulness workshops. This was true for perceived effects on self-esteem, closeness, belonging, and wellbeing at both the post measure and the one-month follow up. While not measured directly, the engagement in the WhatsApp chat for the magic group was low with no shared videos, and only a few thank you messages from students. However, discussions during both magic and mindfulness workshops revealed that at least some students engaged with the homework challenges.

Consistent with prior research on magic and wellbeing (Bagienski & Kuhn, 2019), our results show that participants perceive learning to perform magic as useful in enhancing self-esteem and social relationships. Prior research on undergraduate students during their first term of college suggests that self-esteem tends to either 1) remain stable overall due to an equal amount of students feeling better about themselves as there are for students who feel worse (Harter, 2012, p. 166), or 2) decreases by the end of the first term (Chung et al., 2014). Thus, the self-esteem improvements we found are not likely an artefact of normative adjustment, but instead suggest that the interventions were indeed effective. Practical limitations include a lack of a control that practiced nothing and attrition rates may have resulted in a somewhat self-selected sample.

At first glance, the discrepancy between standardized measures at the three timepoints and the perceived effects is rather perplexing. Indeed, if both groups had improved, one might expect the mindfulness group to be more aware of the positive impact and report higher perceived effects. However, it is important to consider that the content of the mindfulness workshops did not focus specifically on any social or self-components, whereas these topics were much more salient in the magic workshops (e.g. One magic performance included students chanting alternating statements of 'I love me' and 'Not so much'). Thus, while both

workshops improved self-esteem, community belonging, and closeness, as well as decreased depression, anxiety and stress, these benefits may have been more implicit in the mindfulness group (i.e. beyond participants' awareness). On the other hand, the benefits may have been much more explicit in the magic group, to the point that the saliency overshadowed any mindful awareness that led to more accurate self-evaluations. Furthermore, since watching magic may create strong curiosity and interest (Bagienski & Kuhn, 2019; Leddington, 2016), this interest may have generalized to noticing a greater number of positive changes. Lending support to this idea of a more general, introspective awareness is that salient content does not account for the decreases in depression, anxiety and stress since these were not even mentioned during the magic workshops. Whether and how curiosity from magic tricks can be 'attached' to learning material is beyond the scope of this study but a worthwhile line of future research as current studies have mixed results (e.g., Lustig, 1994; Moss et al., 2016).

In terms of self-esteem scales, the main effects of both workshops had medium to large effect sizes. The largest effects were in intellectual self-esteem followed by scholastic, close friendships, creativity, and social-acceptance self-esteem (in order of decreasing effect size). Influences on close friendships and social-acceptance are in line with findings of social support's critical role in maintaining self-esteem during the college adjustment (Friedlander et al., 2007; Harter, 2012). The smallest effects were for global self-esteem and finding humour in one's life. The humour subscale relates to not taking oneself too seriously and since humility was not salient in either workshop, it's reasonable to have a smaller effect size. As for global self-esteem, the smaller effect size might be indicative of workshops not targeting every single area of importance to one's worth in college, such as romantic relationships or uncertainties about vocation. We attempted to minimize the confounds of practicing a skill and social benefits of the comparison group by utilizing mindfulness sessions without any loving-kindness practices. Nevertheless, mindfulness has psychological benefits as well (Chiesa & Serretti,

2009), which may have still been present in our measures and explain why no between groups effects were found. Since different elements of wellbeing also tend to be correlated, (Goodman et al., 2018; Seligman, 2018) mindfulness benefits may have very well carried over into self-esteem. Furthermore, positive interventions with healthy individuals (as is the case here) tend to have small effect sizes (White et al., 2019), albeit more sustainable, than clinical effects. As a consequence, the results from the pre- and post-scales may have been underpowered whereas our perceived measures better detected the unique impact from the magic workshop. Thus, one extension of the current study for future research would be to have a control group that practices no activity at all.

Contrary to results from established scales, the perceived effectiveness of workshops on self-esteem suggests that the magic workshops were more effective than the mindfulness workshops. As noted earlier, the discrepancy could be partly explained due to the salient content in the magic workshop or perhaps an enhanced curiosity and interest that was inspired by the magic. Furthermore, effect sizes were large on the perceived measures, which suggests that perceived measures were more sensitive to the benefits of the workshops than the pre-post comparisons for standardized scales. We suggest that the standardized measures could not detect a between-groups difference because the additional contribution from magic was small and confounded by psychological benefits of mindfulness. Thus, future studies should focus on larger samples to increase statistical power.

For social benefits, results were similar to self-esteem. The main effects from ANOVAs showed community belonging and closeness to have large effect sizes. Our attempts to minimize the social impact from mindfulness may have been thwarted by correlations in elements of wellbeing (Goodman et al., 2018; Seligman, 2018), such as an indirect effect of mindfulness on closeness and community belonging. The lack of social aspects in mindfulness was deliberate in this experiment, which may suggest that while both workshops yielded similar

results, the mechanisms between the two could be very different. For the more sensitive

perceived measures, closeness with other students had the largest between-group difference,

supporting our hypothesis that the magic workshops would have greater social benefits.

For the wellbeing measures, the effect sizes of the ANOVAs were medium. For

perceived effects, the wellbeing question had the smallest effect size, which is not surprising as

the magic workshops did not specifically focus on eliminating depression, anxiety or stress. It is

interesting, however, that the magic groups still perceived the wellbeing benefit, which suggests

that participants were not simply giving a positive response bias due to salient content, as might

be argued for the self-esteem and social benefits. This adds greater weight on the

aforementioned explanation of magic generating curiosity that generalizes to a more general,

introspective awareness.

Limitations of the current experiment include the fact that both groups learned

something, making it difficult to discern how much change from pre- to post- to follow-up can be

explained by practicing a skill. Furthermore, the content of the workshops may have

unmeasured confounds that play a role. Arguably, this may be particularly the case for the

magic workshops, which included music, light physical movement, storytelling exercises, and

discussions on believing in yourself and in the 'impossible'. At a real-world, practical level, these

confounds may not matter if they are all present in the workshop. To determine the unique

contribution of magic, however, it is crucial for future experiments to examine individual

components of the workshops (e.g. simply learning a magic trick, performing magic to a naïve

spectator, test different tricks, etc.). Other limitations include the largely female sample, attrition

that may have created a self-selected sample, and due to the length of the surveys, survey

fatigue may have resulted in careless responding. These could be addressed by incorporating

attention checks in the survey design and utilizing a control that learns no new skills. The lack

of an inactive control, such as a waitlist, may also be seen as a limitation, although we consider

this a strength of the study, since the active control is a conservative test of workshop effectiveness.

Emerging adulthood can be a period of heightened risk for depression and engaging in risky behaviours (Harter, 2012). As such, exploring ways to enhance the college transition experience is critical. Of particular importance is building a means of social support through the college community and maintaining healthy levels of self-esteem. Our preliminary study is the first to suggest that magic workshops may have potential in this context. One of the benefits of such interventions is that they are less prone to stigma because magic tricks are not typically associated with therapy or treatment of low self-esteem. Additionally, they can be useful preventative measures for attracting students with healthy levels self-esteem since one of the unique attributes of magic is the curiosity it inspires by creating impossible moments (Leddington, 2016). Furthermore, by learning to achieve these 'impossible' moments and performing them for others, magic would have positive implications for self-evaluations. Magic is also one of the few performance arts that can be easily applied in intimate, one-on-one social interactions, and thus provide the building blocks of a close-knit community. This sense of community may very well provide the social support needed for healthy college adjustment (Friedlander et al., 2007; Harter, 2012) and ultimately ease the transition. While mindfulness-based interventions could also be helpful for certain students, magic workshops nevertheless provide a more interactive alternative for those students who struggle to engage with passive mindfulness activities like meditation.

In conclusion, the workshops had a positive effect and considering that most studies have shown decreases or stagnant changes in self-esteem when students first adjust to college life, it is unlikely to be a mere case of normative adjustment. The perceived effects may have been more sensitive and thus able to detect between group differences, which suggest that the magic workshops were more useful for self-esteem, closeness, community belonging, and

wellbeing. Although further research is needed, this preliminary study suggests there may be some advantages of magic-based interventions over other types of interventions. Additionally, experiments that separate out the magic from other confounds would be useful for furthering a theoretical understanding.

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Chapter 4: Mastering the Impossible: How an easier-than-expected magic intervention acts as a source of self-efficacy

Abstract:

The greatest achievements often arise from challenging the status quo of what is thought to be possible. These types of achievements require certain beliefs about one's capabilities, but little has been done to explore the value of imaginal self-efficacy sources. We argue that a potent source of self-efficacy is an actual mastery experience that is also perceived as impossible, thus containing advantages of both imaginal and actual success experiences. In part, this is due to the conscious awareness of social reactions to a seemingly impossible event. Based on this, we created a brief arts-based intervention that involved learning a simple magic trick to create an "imaginal mastery experience" and evaluated its impact on sense of mastery. Our results suggest that the intervention enhanced participants' personal sense of mastery. Participants overestimated the difficulty of the trick, while their confidence in performing increased. A thematic analysis on how participants perceived their audience's social reaction revealed that the magic trick involved surprise, curiosity and interest, confusion, and other positive emotions. Psychological theories and directions for future work are discussed.[5]

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[5] This chapter has been submitted for publication to a peer-reviewed academic journal and currently awaiting a decision from the journal.

4.1 Introduction

What once seemed impossible often becomes the greatest advancement of modern times. Whether it is setting a new world record or technology that surpasses human ability, they all start with a belief in one's capability of transforming the "impossible" into reality. For example, Walt Disney described his work as being "kind of fun to do the impossible" (Walker, 1982, p. 10) when he revolutionized the animation industry, earning a record breaking number of Academy awards**.** In psychology, the belief in one's capability to successfully carry out certain actions or behaviours is known as self-efficacy (Bandura, 2008). However, the greatest innovations of the future require self-efficacy in *more* than achieving what has already been demonstrated as possible. They require self-efficacy in one's ability to do something that is not only valuable to society, but also novel in the sense that the achievement borders on the edge of what is currently accepted as possible.

Bandura's model of self-efficacy originates from Social Cognitive Theory, which emphasizes the importance of experiences and the social context in shaping behaviour (Bandura, 2008). However, the model was initially limited as it only accounted for actual, rather than imagined, sources of self-efficacy. The first of these actual sources are mastery experiences, where an individual succeeds in new challenges. However, if the novel goal borders on the edge of what is possible, it is extremely unlikely that the individual can gain a mastery experience for this type of challenge. Bandura's second source of self-efficacy is a vicarious experience, gained through a role model that one can emulate. Similar to mastery experiences, this source is absent for goals that are ambiguous in possibility, unless the role model is imaginary (e.g. fictional characters). Nor does the third self-efficacy source of verbal encouragement and persuasion explain how people achieve things that were once thought to be impossible, unless the persuader encourages a goal that was *imagined* to be possible. The final

source of self-efficacy is by altering physiological and emotional states, which acts as a source of pain or pleasure to motivate successful actions. Although limited, even this physiological source can be influenced by beliefs about what is happening to the body (Olson, 2020; Olson et al., 2020). Thus, a limitation of social cognitive theory was that it did not clarify the role of imaginal sources in self-efficacy, such as how (and if) these imaginal sources lead to achievements that lie on boundaries of what's commonly accepted as possible or impossible.

To address this limitation, James Maddux suggested a fifth source to be imaginal experiences (Gosselin & Maddux, 2003; Maddux, 2001), which typically involves imagining one's self in hypothetical situations. These imaginal experiences can be derived from actual experiences, such as a vicarious source (e.g., a fictional superhero derived from a real-life role model), verbal persuasion (e.g., a therapist guiding a client's imagination) or an imagined extension of an actual mastery experience (e.g., imagining the ability to invent a hang glider after mastering the psychics of parachutes). While imaginal experiences have fewer limitations (i.e. limited only by imagination), they also tend to have a weaker influence on self-efficacy beliefs than actual experiences of mastery (Williams, 1995). Actual experiences of mastery, however, seem to be the most potent source of self-efficacy beliefs (Maddux, 2001; Williams, 1995).

In this Chapter, we argue that an even stronger source of self-efficacy is an *actual mastery experience* that is also *perceived as impossible*, thus containing benefits of both imaginal and actual success experiences. The benefit of imaginal or impossible elements is in expanding and exploring the realm of what is possible, similar to the role of positive emotions in broadening and strengthening one's psychological repertoires (Fredrickson, 2004). This broadening aspect may also play a role in generalizing to multiple life domains instead of a single, isolated skillset. Meanwhile, the actual success experience provides both intrinsic and social validation, which confirms that the individual is truly capable of transforming imaginal

elements into reality. The perception of impossibility is also important in at least two other regards. First is the stark contrast between 1) the initial evaluation of a task being impossible and 2) the subsequent experience of executing the "impossible" task successfully. This forces the individual to challenge prior beliefs about the limits of their capabilities, which naturally leads to wondering what *else* they might be capable of. The second role of perceived impossibility is to provide social validation from the reactions of others. If others *also* deem the task to be impossible, they will react accordingly when seeing the impossible event, thus confirming the successful accomplishment.

4.1.1 Designing an "impossible" intervention

To create such an activity that optimally increases self-efficacy, it would require 1) a task that is commonly perceived as impossible (or at the very least, ambiguous in its possibility), 2) an opportunity to receive social validation in the form of reactions that imply the impossible became possible, and 3) the task to be practical enough for participants to successfully learn and accomplish the skill in a reasonable amount of time.

One activity that clearly meets the first two criteria is magic: the art of performing the impossible. The experience of watching magic results in a conflict between what we know to be possible and what we directly perceive as impossible (Kuhn, 2019; Lamont, 2017; Leddington, 2016; Parris et al., 2009). Since magic tricks are experienced as both possible and impossible, this allows them to satisfy the first requirement of perceived impossibility. Furthermore, this conflict is also reflected in the experience of performing magic because the performer's secret knowledge asserts the trick to be possible, whereas social reactions to the magic imply that the impossible did indeed become possible (even if only for a moment). As a result, the magician gains the equivalent social validation of achieving the impossible, for a success experience that is very much possible and achievable in the mind of the magician.

To satisfy the practicality requirement, the magic trick in the self-efficacy intervention would need to be sufficiently simple to be accomplished in a reasonable amount of time. Professional magicians often spend entire careers designing and rehearsing magic performances, creating new secret methods for tricks, and practicing performances for countless hours (Rissanen et al., 2014). However, there is a subset of magic tricks known as "self-working" tricks that require less time to master (Fulves, 1990; *Self-Working Magic*, n.d.). For these, the magical effect occurs automatically, when simple instructions are followed. Furthermore, the perceived difficulty of learning these tricks is more likely to be overestimated since the actual secret is rather simple. Thus, self-working tricks are ideal for designing a magic-based, self-efficacy intervention that maximizes the chance of participants successfully performing the trick.

Preliminary evidence for why magic might enhance self-efficacy comes from prior studies showing that learning to perform magic can boost self-esteem. Self-esteem increases were observed in studies of children with disabilities (Ezell & Klein-Ezell, 2003; Fancourt et al., 2020; Spencer, 2012), in English language learners[6] (Spencer & Balmer, 2020) and in first year undergraduate students (Bagienski & Kuhn, in press). Themes of pride have also been observed qualitatively from descriptions of discovering secrets to magic tricks (Danek et al., 2014). Furthermore, a systematic review of the research on magic and wellbeing (Bagienski & Kuhn, 2019, 2020) observed that increases in self-esteem and feelings of pride were only present when participants *learned to perform* magic but no such studies existed on the impact of merely watching magic.

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[6] While results showed numerical self-esteem increases for all but one student who maintained self-esteem, no statistical significance tests were reported, presumably due to a small sample size of 21 students.

4.1.2 Potential pathways from magic to mastery

The mechanisms for how learning to perform magic enhances self-esteem are not fully understood but one possible pathway is through a generalized self-efficacy that originates from mastery experiences that are perceived as impossible. Since this type of mastery experience has imaginal elements that may broaden one's psychological repertoire, the self-efficacy may expand to other domains beyond magic itself and thus increase one's self-esteem via an overall self-evaluation.

In addition to this, self-efficacy in performing magic may mediate self-esteem if magic is inherently valued by individuals. As described by James (1892), self-esteem arises when one's perceived success in *valued domains* meets the expectation of one's self in that domain (i.e. self-efficacy as a prerequisite for this expectation). Learning magic may be valued at a primitive level as evidenced by experiments in both children and adults, showing that tricks presented with a magical causation were interesting to explore (Subbotsky, 2010). Furthermore, many are driven to figure out how a trick works, which may suggest that learning the secret is valued, and this aligns with research on how people place greater value on things (e.g. secret knowledge) that are scarce (Cialdini, 2007). The idea of magic being inherently valued becomes more apparent when reframing the process of learning magic as "understanding what's possible", which is a domain that humanity would need to value for evolutionary reasons of constructing an accurate reality in order to survive.

The latter aspect of self-esteem arising from meeting (or exceeding) one's expectations is also very likely in performing magic. People tend to set aspirations and expectations of themselves in the realm of possibility, which means expectations of achieving the "impossible" would be low for magic. Thus, at a certain imaginary level, learning to perform the impossible would necessarily *exceed* one's expectations and ultimately enhance both self-efficacy and self-esteem.

The mechanism by which the performance of magic provides social validation to the performer through its social reactions also remains unknown. In this regard, we anticipate that curiosity plays a dual role. Firstly, curiosity about the trick's secret sends a message to the performer that they executed the trick successfully. Secondly, this curiosity may act as a social reinforcer by being perceived as an interest in learning more about the performer. Furthermore, this type of reaction reflects a social response that cultivates positive social relationships. This well-documented characteristic of positive relationships is that the people involved respond to good events in an active and constructive manner (Gable et al., 2004, 2006), which has been replicated in new interactions with complete strangers (Kleiman et al., 2015). These active constructive responses are characterized by 1) enthusiasm and 2) encouraging the sharer of the good event to relive that moment, thus capitalizing on associated positive emotions. For magic, the latter part is reflected in curiosity, where the responder genuinely wants to learn more about the good event. In performing magic, the "good event" is the ability to execute the trick successfully, which is shared by performing it. Moreover, the perceived enthusiasm originates from a combination of the surprise that magic elicits (Harris, 1994; Parris et al., 2009; Vidler & Levine, 1980) along with other positive emotions that magic is thought to elicit, such as humour (Leddington, 2020), awe (Bagienski & Kuhn, 2019), and joyous exploration curiosity (Bagienski & Kuhn, 2019). Thus, this social validation would further reinforce the mastery experience by facilitating a positive relationship between performer and spectator.

4.1.3 The present study

Thus, the current study aimed to primarily test the hypothesis that performing magic would increase self-efficacy, by providing the individual with a sense of mastery. If true, this lends support to the mechanism of self-esteem being increased via actual mastery experiences that are perceived as impossible. To further examine whether self-efficacy in performing magic would generalize to other domains, we examined how participants process real life, problem-

solving scenarios.   In addition, we set out to investigate some of the hypothesized mechanisms. The first was to test the prediction that, for self-working magic tricks, people's expectations of their ability to perform the magic trick are lower (i.e. more difficult) than the actual difficulty of performing the trick. This means that performing magic would exceed initial expectations of one's ability to perform the "impossible" magic trick. Secondly, we conducted an exploratory analysis to investigate the mechanism of perceived social reactions that could act as social validation of the mastery experience. We hypothesized that these reactions to magic tricks would reflect active-constructive responses and contain emotions of curiosity, surprise, and positive emotion.

4.2 Methodology

4.2.1 Participants

Participants were UK sixth form[7] students in London attending an open day at the University who were considering an undergraduate psychology degree. All participants were recruited via the university's recruitment team. The final sample consisted of 75 students (9 male, 64 female, and 2 undisclosed genders) with mean age of 17.43 (SD =3.46). Participants took part in the study before a presentation on the school's undergraduate psychology program.

4.2..2 Procedure

The magic trick lesson was based on a segment from the magic workshops reported elsewhere that yielded improvements in self-esteem for undergraduates (Bagienski & Kuhn, 2021). Two tricks were selected and they were as similar as possible to minimize confounds. The tricks used the same type of props and had the same magical effect. This magical effect

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[7] Sixth form is the United Kingdom is roughly equivalent to high school in America.

began with the magician holding two long pieces of either rope (or string). He then magically combined the two separate pieces of rope (or string) into one long piece by using a magic gesture or some "invisible" magic dust. Although students learned the same magical effect, the secret method for each group was different (*Professor's Nightmare*, n.d.; Sankey, 2010). This was to ensure performances would yield a genuine reaction from the opposite group, uncontaminated by their audience knowing the secret. Furthermore, we maximized the chance of students having a successful performance by 1) choosing simple, effective self-working magic tricks, and 2) having participants perform tricks for a spectator naïve to the secret method, so they gain social validation of their success. Both the performances and lessons were stripped of entertainment and presentational elements (e.g. jokes, stories) to minimize any confounding factors.

An outline of the procedure is shown in Figure 1. Before learning tricks, students first completed baseline mastery measures. Next, they were split randomly into two groups of equal size that were physically separated, with a different instructor for each group. After seeing their respective magic trick performed, they completed the remaining baseline measures. These consisted of measuring the perceived difficulty of learning the trick, their confidence in being able to perform the trick, and how much they think they would enjoy learning the trick.

After watching the magic trick, participants received the necessary props and were taught only the bare mechanics needed for the trick to be perceived as impossible by others. No other theatrical or entertainment elements were taught (e.g., jokes, stories). Immediately after the group lesson, students were given time to practice, and individual help was given to students as needed. This ensured that every participant understood the trick well enough to perform for the opposite group. Students were also instructed to not reveal the secret to the trick, even if asked. This session lasted approximately 10 minutes.

The two groups were then brought together by forming two straight parallel lines with students facing each other, such that every student did a one-on-one performance to a student from the opposite group. All participants then took turns performing their magic trick for their performing partner. After all participants performed, they went back to their seats to finish the post-measures. The entire intervention, including questionnaire time, lasted no more than 30 minutes. Procedures and measures were approved by Goldsmiths University's ethics committee.
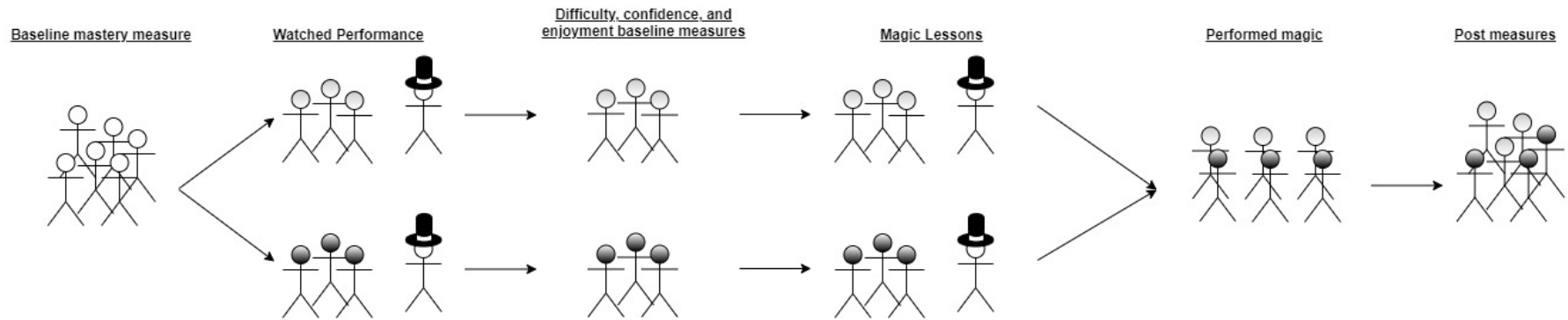
Figure 1. Diagram providing an overview of the procedure, including timepoints where measures were taken. Different shading reflects

the two different secrets methods learned by participants.

4.2.3 Measures

All measures and item-wordings for the questionnaires can be viewed in the supplementary material. Students were instructed to only continue measures at the appropriate times as described in the procedure section.

Mastery

To measure sense of mastery, we utilized the Pearlin Mastery scale (Pearlin & Schooler, 1978). The scale measures the extent to which an individual regards life outcomes as under their personal control as opposed to fate or external factors, which closely mirrors the theoretical construct of self-efficacy. It utilizes a 4-point Likert scale with responses ranging from "Strongly disagree" to "Strongly agree". For our study, reliability was good for both pre (Cronbach alpha = 0.73) and post (Cronbach alpha = 0.75) measures.

We also included a post-intervention question asking participants to rate on a 5-point Likert scale whether the activity affected their perspective on mastering new skills. If it had, participants were asked to explain how and why in a qualitative, free response question.

Mastery of Social Problem Solving

To examine generalisability to other areas of life, we utilized scenario tasks from the Means Ends Problem Solving Task (MEPS, Platt & Spivack, 1975). This task presents a scenario with a problem in 2nd person point of view, along with an ideal outcome. The steps on how to achieve the outcome are omitted and participants are asked to fill in this "middle" part of the story. A total of four scenarios were presented on the questionnaire printout where students wrote their responses. The situations were designed to be of relevance to students about to undergo the college transition. These scenarios were 1) receiving a poor grade on an A-level midyear exam, 2) feeling homesick after starting college, 3) making new friends at university, and 4) a long-distance romantic relationship

due to different choices of university. The scenarios were counterbalanced such that each of the four scenarios were present in pre- measure for exactly two of the four conditions.

Difficulty, Confidence and Enjoyment

To test our hypothesis that learning to perform magic would exceed initial expectations, we first asked participants about their perceived difficulty both before and after performing the magic trick. The item was rated on a 5-point Likert-type scale. To avoid students accidentally rating the difficulty of figuring out the secret, the item intentionally clarified that they are to rate the difficulty assuming someone was teaching them the trick.

To confirm that perceived difficulty translated to confidence in one's ability to perform the magic trick, we also asked students about their confidence in performing the trick both before and after they performed the magic trick. This item was analogous to the question on perceived difficulty in terms of phrasing and a 5-point Likert-type scale.

To test whether students accurately predict their enjoyment of learning and performing the magic trick, we also asked about their anticipated and actual enjoyment of learning the magic trick. These followed an analogous format as the prior questions on difficulty and confidence. The rationale for this comes from the prolific rule of magicians to never reveal secrets to the magic because it would spoil the enjoyment of wonder and mystery. This rule presumes that audiences may overestimate the enjoyment of knowing the secret. Thus, we wanted to confirm that our participants enjoyment from learning and performing magic would not be undermined by learning the secret to the magic trick. That is, any loss of enjoyment from figuring out the secret would be compensated by the increase in enjoyment from learning and performing the trick successfully.

Social validation of successful performance

To investigate how social reactions to magic might act as validation of the mastery experience, we included an open-ended question asking students to describe their spectator's reaction during the magical moment of the performance.

To further explore the emotional content of this social reaction, the item after the open-ended response instructed students to choose three of 27 possible emotions. The 27 emotions were from Cowen and Keltner's (2017) analysis of emotional states in response to emotionally evocative videos. We chose the emotions from this study because 1) the magical effect was predominantly visual just like Cowen and Keltner's videos, and 2) the list was broad enough to distinguish various types of positive emotions.

4.2.4 Analyses

Mastery

Repeated measures t-tests were carried out on scores from the Pearlin mastery scale using SPSS Statistics 24. If one or more mastery question was not answered, that student was excluded from the analysis since scoring is calculated from summation of item scores (Pearlin & Schooler, 1978). If a post measure was missing for the scenario tasks or perceived impact, the participant was excluded for that corresponding analysis.

For the perceived impact on mastery, a one sample t-test was conducted against the value of 3 (indicating no positive nor negative change). Values above three indicated that learning the trick positively affected the participant's perspective on mastering new

skills whereas less than three would indicate a negative impact. Thematic analysis was used for the free-response question, where two coders independently assigned codes and generated themes. After themes were generated, the two coders reviewed and discussed the themes together before deciding on the final themes.

Mastery of social problem solving via MEPS task:

MEPS solutions were first transcribed and blinded by a third party so that neither researchers nor coders knew which scenarios were presented before or after the intervention. Next, the main researcher coded all scenarios for means ends as per protocol (Platt & Spivack, 1975), counting the number of discrete steps. An instruction sheet was created to clarify what counts as a discrete step, which was given to a second researcher along with the transcribed scenario responses. There were three coders in total, including the main researcher. Inter-coder reliability was estimated using Krippendorff's alpha test (Hayes & Krippendorff, 2007), and these alpha values are the ones used in the results section below. For the Means End Problem Solving scenario scores, the blind codes were revealed only after all coding was completed by all three raters. The mean of the three scores from raters was first calculated for each scenario for the participant. Next, the two scores corresponding to the two pre intervention scenario tasks were averaged together to obtain a final "pre" score for that participant and this was repeated for obtaining a final "post" score for each participant. A paired samples t-test was then conducted to compare baseline mastery to post-intervention mastery. To ensure that scores between each of the counterbalanced conditions were not significantly different from each other, one-way ANOVAs were carried out, separately for pre- and post- scores, with the counterbalanced conditions.

Difficulty, confidence and enjoyment

Independent samples t-tests were conducted for the difficulty, confidence, and enjoyment items between the pre and post scores. To examine the relationship between difficulty and confidence in performing the trick a correlational analysis was performed.

Social validation of successful performance

For the open-ended question on their spectators' reaction, thematic analysis was used once again. The two coders independently assigned codes and generated themes before the coders compared and finalized the themes.

4.3 Results

We evaluated the impact of the intervention on mastery beliefs and the change in students' perceived difficulty, confidence, and enjoyment. A total of 75 students (64 female, 9 male, 2 undisclosed) participated in the intervention. Statistical analyses were carried out using IBM SPSS Statistics 24 software. A summary of means and standard deviations is presented in Table 1.

Table 1 *Means and standard deviations for Pearlin mastery scores, and difficulty, confidence, and enjoyment ratings.*

	Time	
	Pre	Post
Pearlin Mastery	19.80 (3.15)	20.52 (3.11)
Means Ends Problem Solving Tasks	2.61 (0.92)	2.61 (0.92)
Difficulty	2.81 (1.08)	1.81 (1.04)
Confidence	3.21 (1.05)	3.95 (1.20)
Enjoyment	3.70 (1.08)	3.78 (1.00)

4.3.1 Mastery

Pearlin Mastery Scale

We predicted that participant's sense of mastery would increase post intervention. Six

participants (5 female; 1 undisclosed) failed to meet the inclusion criteria for the analysis.

As predicted, results showed that compared to pre-intervention scores for Pearlin

Mastery (M = 19.80, SD= 3.15), post-intervention scores (M = 20.52, SD = 3.11) were

significantly higher after the intervention, $t(68)$ = 3.60 , p < .001, cohen's d = 0.43. This

suggests that the intervention may have affected mastery beliefs, such that participants

had a sense of agency in their ability to master new skills as opposed to external factors

deciding what they're capable of.

4.3.2 Perceived impact on mastery

To evaluate whether participants also noticed a change in perspective on mastering new

skills, a single sample t-test was conducted after excluding two participants (1 female; 1

undisclosed). The mean score of 3.56 (SD = .66) indicated a slight perspective change

in a positive way. This mean was tested against the value of three (i.e. no impact) and

the result was significantly greater than three, $t(73)$ = 7.44 , p < .001, cohen's d = 0.87.

This suggests participants perceived that the intervention positively changed their

perspective on mastering new skills.

4.3.3 Thematic Analysis for Perceived Impact on Mastery

From the qualitative responses, the resulting codes were condensed to eight unique

themes to describe the data via thematic analysis. After comparing and revising themes,

the final list of themes in decreasing order of frequency consisted of 1) Perceived

difficulty was much easier than initially expected, 2) Success and achievement coming

from hard work, practice and persistence despite the struggles, 3) Broadening or

expanding of ideas, getting curious about how things are done, and realizing their

capacity for their abilities to expand, 4) An optimistic mindset where "anything is

possible", 5) Increased self-confidence or self-esteem in their ability to perform the trick,

6) Being open-minded to attempt new things, new ideas, and not doubting one's ability,

7) A problem-solving mindset for critical thinking and breaking down problems into

smaller chunks, and 8) Not as easy to perform as expected. The final two only occurred

twice and themes with only one occurrence were not counted. The two most prevalent

themes, the perceived difficulty becoming easier and success coming from practice or

hard work, both occurred approximately nineteen times. The theme of broadening

occurred approximately twelve times, followed by an optimistic mind occurring eight

times. The Self-confidence and open-minded themes occurred about 6 and five times,

respectively.

4.3.4 Mastery of social problem solving via MEPS task

For scenario tasks, eight participants (7 female; 1 undisclosed) failed to meet inclusion criteria.

There was low inter-rater reliability (Krippendorff, 2018) between raters for all four scenarios: the

long distance relationship (α = 0.712), feeling homesick (α = .658), receiving a poor mark on an

exam (α = .716), and making new friends (α = .723). One-way ANOVAs did not reveal any

significant differences for type of scenario in either the pre measures, $F(3, 63) = 0.59$, $p = .63$,

nor the post measures, $F(3, 63) = 1.59$, p = 0.2.

The paired sample t-test used to evaluate the generalisability of mastery to other life

skills indicated no significant difference for the MEPS task from pre (M = 2.46, SD = 0.88) to

post (M = 2.61, SD = 0.92) intervention scores, $t(66) = 1.15$, $p = .25$.

4.3.5 Difficulty, Confidence, & Enjoyment

We predicted that from pre to post intervention, the perceived difficulty of magic would

decrease, confidence would increase, and that enjoyment would not be spoiled by learning the

magic. Furthermore, we predicted an inverse correlation between confidence and difficulty, in

line with our prediction that exceeding one's expected ability to perform magic originates from overestimating the difficulty

For the pre- and post-analyses on difficulty, confidence, and enjoyment, two participants were excluded (1 female; 1 undisclosed) for missing data. As predicted, results showed a significant decrease in the perceived difficulty after the intervention, $t(72) = 7.56$, $p < .001$, $d = 0.88$. Similarly, the confidence in performing the magic trick rose significantly after performing, $t(72) = 4.82$, $p < .001$, $d = 0.56$.

To analyse the inverse relationship between perceived difficulty and confidence in performing the magic trick, one-tailed correlational analyses were carried out. For the baseline measures, there was significant inverse correlation between difficulty and confidence in performing the magic, $r(72) = -.38$, $p < .001$. Post measures showed a somewhat weaker but still significant inverse correlation, $r(71) = -.24$, $p < .05$. These correlations were consistent with our hypothesis that students would have less confidence in performing more difficult magic tricks. The change scores, however, did not have a significant correlation, $r(71) = -.15$, $p = .10$ suggesting that difficulty decreases were not the only factor in increasing confidence.

As for enjoyment, there was no statistically significant change between their anticipated and actual enjoyment of learning to perform the magic trick, $t(72) = 0.75$, $p = .46$.

4.3.6 Social validation of successful performance

From thematic analysis, the codes generated were condensed to eleven unique themes to describe all the data. After comparing and revising themes, the final list of themes were 1) Intense shock and surprise with a few participants experiencing slight surprise, 2) Curiosity, interest, and intrigue, commonly related to how the magic effect occurred, 3) Confusion, 4) Neutral reactions or very little reaction, 5) Sarcastic or faked reactions, 6) Emotions or expressions that communicate a respectful admiration, validation or approval of the magic performance, 7) Energetic positive emotions, 8) Low energy positive emotions, 9) Mystical and

magical emotions of awe-like wonder, 10) Uncomfortable emotions, and 11) A desire to see the trick repeated. The most prevalent theme was shock and surprise with 30 students using the words "shocked" or "surprised" to describe the reaction of their spectator. The second most common theme was curiosity or intrigue with 15 students, often using words like "curious", "interested", "intrigued", or wanting to figure out the secret to the trick when describing the reaction. The third most common theme was confusion with 12 students directly saying that their spectator looked "confused". The remaining themes had somewhat similar frequencies with themes ranging from 5 to 12 occurrences among participants, except for three themes that each occurred less than 5 times. Those were sarcastic or fake reactions, uncomfortable emotions, and a desire to repeat the trick.

Due to a clerical error, three of the necessary emotions were not displayed in the survey and replaced by three incorrect emotions that were ultimately removed from Keltner et al.'s analysis (Cowen & Keltner, 2017), which unfortunately undermined the analysis.

4.4 Discussion

We designed and investigated a brief magic-based intervention to better understand how self-efficacy is affected by an actual mastery experience that is perceived as impossible. Students learned and performed a self-working magic trick. During both baseline and post measures, we assessed their self-reported sense of mastery, perceived difficulty of the trick, confidence in performing it, and their enjoyment of the intervention. As predicted, sense of mastery increased along with confidence, while perceived difficulty decreased. No change in enjoyment was found, suggesting that participants were accurate in predicting how much they would enjoy learning to perform the trick. Additionally, we used the MEPS task (Platt & Spivack, 1975) to examine whether the perceived enhancement in mastery would generalize to other social contexts. Inter-rater reliability was low for these ratings and no statistically significant changes

were observed in the scenario tasks. Lastly, we conducted a thematic analysis of the perceived social responses to participants' performances to explore the role of social validation in creating a pseudo-imaginal, mastery experience. Overall, results showed that participants overestimated the difficulty of the magic trick, underestimated their ability to perform the magic, and subsequently experienced a stronger belief in their ability to master new skills upon performing the tricks successfully. The thematic analysis on the social validation of the performance revealed that reactions were predominantly characterized by 1) surprise, 2) curiosity, interest, or intrigue, and 3) confusion.

The enhanced sense of mastery indicated by the increase in scores of the Pearlin Mastery scale provides preliminary evidence for the mechanism of imaginal mastery experiences affecting self-efficacy, which ultimately enhances one's self-worth (i.e. self-esteem). We use mastery to be analogous to self-efficacy since the Pearlin mastery scale measures beliefs about the extent to which one has control over one's life outcomes, while self-efficacy is the belief in one's capability to control or achieve those outcomes.

While self-efficacy does not necessarily lead to self-esteem, the benefits of performing magic on self-esteem improvements have been documented in both disadvantaged children (Ezell & Klein-Ezell, 2003; Spencer, 2012) and first year undergraduate adults (Bagienski & Kuhn, 2021).

Others have highlighted that self-esteem is more related to affective variables whereas self-efficacy is more related to motivational aspects (Chen et al., 2004). Affective components present in magic could very well stem from entertainment elements such as humour, storytelling and share commonalities with the self-esteem improvements observed in other arts interventions (Fancourt & Finn, 2019). However, the confound of related performance arts is unlikely because magic lessons in our intervention were intentionally devoid of these entertainment elements. Furthermore, participants were not instructed to include any sort of

personal creation in their magic performance. By contrast, motivational elements of self-efficacy are more closely related to the intense curiosity that arises from witnessing an impossible moment — an aspect unique to magic (Leddington, 2016). The experiment was limited in that we did not directly measure self-esteem, which would have helped reveal whether self-efficacy mediates self-esteem in the context learning to perform magic. On the other hand, evidence of self-efficacy playing a mediational role in other contexts is supported by both prior research on self-esteem meditated by self-efficacy in regards to workloads (Molero et al., 2018), and models of self-esteem mediated by emotional and interpersonal self-efficacy (Caprara et al., 2010). This mediational role of self-efficacy on self-esteem, evidence from prior magic studies on self-esteem, and results from the present study altogether suggest that the self-efficacy from imaginal mastery experiences in magic may very well mediate its impact on self-esteem. Thus, while affective components may play a role, our study was the first to investigate this mechanism of self-efficacy driving a potential self-esteem increase by undergoing an actual mastery experience that is perceived as impossible.

Another motivational aspect of this type of mastery experience appears to be the social validation students receive from performing the trick. Despite knowing it was a trick, students obtained a first-hand experience of creating an impossible magic moment for someone else. Similar to how spectators experience a conflict between what they know is possible and what they perceive, our performing participants were likely to experience a conflict between what they know to be true (i.e. the trick's secret) and what their spectator's social reaction conveyed (i.e. that the performer did something impossible). This moment is likely short-lived and fades as the spectator begins to rationalize what happened. Nevertheless, the reaction still provides the performer strong evidence that they performed the trick successfully, in at least two ways. First is that the "impossible reaction" suggests that the secret was not discovered, which is viewed as a success in performing magic. The second is on an imaginary level where the "impossible

reaction" suggests that something impossible did indeed happen and that the performer was the one responsible for making it happen. The themes from the qualitative data reflect this with participants perceiving reactions to be characterized by surprise, curiosity, interest, and range of positive emotions that include awe-like emotions of being "amazed", amusement, and higher energy positive emotions like excitement. All these emotions could also be reasonably experienced when first seeing or hearing an amazing new achievement for the first time ever. The predominant themes of surprise and curiosity also mirror the interest and enthusiasm of active constructive responses (Gable et al., 2004, 2006) in developing positive relationships (Kleiman et al., 2015), which appear to play an important role in the social validation of their performance success and warrants further research.

Lastly, our results support the hypothesis that these changes may stem from participants' expectations about the intervention. Participants largely overestimated the difficulty of performing the tricks and underestimated their ability to perform the trick. These two measures were inversely correlated as anticipated. On the other hand, change scores of difficulty and confidence were not significantly correlated. This indicates that the decrease in perceived difficulty was much larger than the corresponding increase of confidence. In part, this could be due to a negativity bias (Vaish et al., 2008) in self evaluations, where there is more heightened attention on negative self-aspects in performing (i.e. incompetence, a focus on minor performance flaws) than on neutral or positive events (i.e. the decrease in perceived difficulty). Additionally, not all students performed flawlessly, with a minority accidentally revealing the secrets, which could have undermined their confidence in their ability to perform the trick. These imperfect performances may have been the result of the brevity of the intervention which lasted no more than 25 minutes in total, including questionnaire time. Finally, since performances were all done in the presence of other students, standing shoulder-to-shoulder, there are likely group dynamics at play and social comparison biases, which would

dampen the increase in one's confidence, particularly for participants who did not perform as well as others. Thus, while the change scores in confidence were not as large, the general inverse correlation between confidence and difficulty was nevertheless present, as observed by examining the baseline and post measures individually.

The importance of overestimating the difficulty, while underestimating one's ability was also reflected in thematic analysis of how the intervention changed their perception of mastering new skills. In fact, this theme was the most frequently cited source in the thematic analyses. The frequency of this theme, however, should be interpreted with caution since the prior confidence and difficulty items may have primed students to respond in this way. On the other hand, it is hard to imagine finding our quantitative result of decreasing difficulty and increasing confidence to persist for other artforms, such as juggling, where the skill might look easier than it is in reality. Overall, this overestimation of difficulty for self-working magic tricks appears to play an important role in magic interventions that should be investigated further.

Although this pilot intervention suggests it had a positive impact, one of the greatest limitations of our study is the lack of a randomized control group. While a positive response bias is another possible limitation, the increase from pre to post scores on the Pearlin Mastery scale suggest that if such a bias exists, it is more pronounced in the post measure and thus, more likely to be either a practice effect, demand characteristic or a genuine outcome of the magic intervention. Considering the intervention elements itself entailed no explicit content related to concepts of mastery, it is unlikely that students were primed for mastery in post measures. Another possibility is that the higher post scores may simply reflect a momentary increase in positive mood. If so, then at the very least, this intervention could provide a useful therapeutic tool to enhance positive mood. Other limitations include the use of purely self-report measures and convenience sampling of high school students attending an open day. Additionally, the low reliability of the scenario tasks analysis somewhat undermines our ability to

comment on its generalisability to other domains.   Lastly, our study is limited in that we cannot discern how much of the impact arose from watching the magic performance, guessing and learning its secret, practicing tricks with others, and/or the actual performance element. If students had correctly guessed the secret, for example, this could have a positive impact as prior research suggests discovering secrets to magic is associated with a release of pride and tension release (Danek et al., 2014).

Therefore, future studies would benefit most from firstly utilizing a comparable control group. An inactive control would be useful for separating out response biases whereas active controls could be helpful in comparing its effectiveness to other therapeutic techniques. Measures of self-efficacy alongside self-esteem would also help clarify whether self-esteem is mediated by self-efficacy. Other useful measures for future studies would be observational or behavioural measures, enjoyment compared to other techniques, and a measure of magic's internal conflict between what one is perceiving and what is known to be possible – for both performer and spectator. As a next step to isolate components of the intervention, future work can take measurements after they learn the secret, and after they practice the tricks, and once more after they perform for each other. Lastly, investigating tricks of varying difficulty could provide further evidence that the key factor in the magic intervention is an overestimation of the trick's difficulty.

Another potential route for future research is to examine the role of curiosity in motivating students to learn and perform magic, since prior studies suggest watching magic may be useful for learning (Wiseman et al., 2020; Wiseman & Watt, 2020). Ultimately, this could encourage participants to engage or generalize their motivation to subsequent content. For example, if self-efficacy increases because of the magic intervention, then this could be used as an experiential learning moment that is followed by lessons on mathematics, science, dance, or the chosen area of interest.

In conclusion, this brief intervention used self-working magic tricks and the most notable finding was that participant's self-efficacy seemed to arise from overestimating the trick's difficulty and therefore underestimating their ability to have a successful experience performing it. The social validation revealed themes of intense surprise as well as curiosity, intrigue, and confusion. We theorize that this is the result of an actual mastery experience that is perceived as impossible: both initially before the secret is learned and later on by their spectator. We hope future research will help clarify and test mechanisms, further explore the unique benefits of magic interventions and ultimately lead to meaningful applications of making the impossible become possible.

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Part III: Watching Magic

Part III Introduction

Appreciating the impossible is valued by society. This is observed in everyday life, from the impossible fantasy moments in movies and fiction (Subbotsky, 2010) to the ground-breaking technologies that bring ideas to life that were once thought to be impossible, (e.g. spinach sending email; Wong et al., 2017).   Making the impossible seem possible is central to the performance art of magic. In the previous section, we observed that learning to perform magic was found to increase self-esteem and one's sense of mastery. These benefits largely arose from the socioemotional reaction to the participant's magic performance. This reaction resulted in participants experiencing an unexpected success in performing the magic trick while also providing socioemotional validation of their success. Thus, understanding the spectator's socioemotional reaction is crucial if we are to fully understand the wellbeing benefits of magic-based interventions. Moreover, these insights will help optimize the use of magic for subsequent interventions. Specifically, it is important to understand why people enjoy magic, since these positive (or mixed) emotions likely play a vital motivational role that would be required to optimize psychological wellbeing applications.

Since perceived impossibility is central to magic, Chapter 5 begins by examining the relationship between impossibility and magic enjoyment. Acknowledging that individual differences may exist for the enjoyment of magic, Chapter 6 investigates whether magic enjoyment is related to the Big-5 personality traits and individual differences in locus of control. These individual differences are further explored in Chapter 7 by using a five-dimensional curiosity scale to determine how people enjoy the secrets of magic, since curiosity is very common in magic. Expanding upon the emotional enjoyment of magic, Chapter 8 concludes by investigating wonder in a series of experiments that investigates how awe is present when watching good magic tricks. Throughout the following section, we will refer to "the magic

experience" or "magic" as the experience of watching magic tricks in a performance context, for entertainment purposes. This contrasts with the performer's experience or other conceptualizations of the word "magic", such as magical thinking or mystical fantasy stories.

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Chapter 5: Balanced Enjoyment of Magic: A brief, arts-based state intervention for enhancing feelings of mastery

Abstract:

The performance art of magic allows us to experience the impossible, and this study used a magic trick to investigate the relationship between participants' enjoyment and perceived impossibility. Participants watched a live performance of a magic trick in which the magician balanced objects in progressively more impossible configurations. At 7 different time points observers rated their enjoyment, and the extent to which what they saw was impossible. Regression analysis revealed that participants' enjoymen[8]t of the magical effect relates to their perceived impossibility of the magic trick, and this relationship was independent of how much they enjoyed magic in general. Moreover, a one-way within-subjects ANOVAs analysis showed that participants enjoyed the performance more as it became more impossible. However, once the magical effect was anticipated, enjoyment began to plateau while perceived impossibility continued to increase. These results are discussed in the context of people's aesthetic appreciation of magic and current arts appreciation models.

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[8] This chapter has been prepared for publication in an academic journal. At the time of this writing, it is not submitted for publication to a journal.

5.1 Introduction

Impossibility is at the core of a magic performance. The cognitive and perceptual mechanisms of these perceived impossibilities have been the focus of a recent growing body of literature (Kuhn, 2019; Kuhn et al., 2008; Rensink & Kuhn, 2015). However, very little empirical work exists on how or why people enjoy these impossible moments. In fact, it is difficult to find more general theoretical frameworks on why or how people enjoy the performing arts. In this chapter, we examine the link between enjoyment and perceived impossibility of the magical arts.

There has been much empirical interest in arts appreciation (e.g. Bullot & Reber, 2013; Rose et al., 2020; Ruth & Müllensiefen, 2020) and on a macroscopic level we find broad theoretical frameworks, which partly explain the enjoyment of magic. However, these frameworks seem too general to capture the unique aspects of magic. For example, Bullot & Reber (2013) proposed an influential model of arts appreciation, which discusses three modes of appreciation: basic exposure, the artistic design stance, and artistic understanding. The artistic design stance is "an attitude whereby appreciators develop their sensitivity to art-historical contexts by means of inquiries into the making, authorship, and functions of artworks" (Bullot & Reber, 2013, p. 123). For example, people appreciate a painting more when given descriptions about the artist's technique, the materials used, and other information about the artist's style (Belke et al., 2006). It is hard to see how this artistic design stance can be directly implemented to explain people's enjoyment of magic. Magic is unique in that the performer intentionally withholds information about the method and material used to create the performance, and it is this secrecy and deception that enables the experience of the impossible. Unlike most other artforms, the true authorship of magical effects is also frequently absent to prevent audiences from discovering the secrets. Most other arts allow us to marvel at the creation of the artwork (e.g. the artist's effort and skills). However, people appreciate magic

because this aspect is withheld, in the aim of creating an impossible experience. While an appreciation of the art-historical context can still exist (e.g. magicians debunking paranormal claims during a spiritualism movement), the majority of the artistic design stance is nevertheless absent. Therefore, this psycho-historical framework is limited in that it does not distinguish how arts can be enjoyed when the artistic design stance is largely absent. Thus, we must look elsewhere for insights on why we enjoy magic.

The most comprehensive theories on why we enjoy magic originate from philosophy and the work of professional magicians. Leddington suggests that the experience of magic results from a cognitive conflict, which arises from an incongruity between perceiving something as impossible and knowing that our perception is fake, yet lacking any evidence to explain why our perception is fake (Kuhn, 2019; Lamont, 2013; Leddington, 2016a). As a result, this can yield a heightened sense of curiosity as the magician provides ample counterevidence for any rational explanation that a spectator can surmise (Leddington, 2016b). This heightened curiosity is one emotion that may play a role in our enjoyment of magic.

Aside from curiosity, there is likely a set of emotions related to magic enjoyment. Magic can elicit a range of pleasant, unpleasant, or mixed emotions, such as awe and surprise, both of which can have positive or negative valance (Noordewier & Breugelmans, 2013; Yaden et al., 2018). The link between magic enjoyment and positive emotions is more intuitive and a case for magic as a form of comedy has been discussed elsewhere (Leddington, 2020). However, the paradox of enjoying negative emotions is more complex. One explanation for how we can enjoy this complex set of emotions stems from the distancing-embracing model, which suggests that the safe context in which magic is performed allows the viewer to distance themselves from the negative emotions. This distancing process allows the viewer to embrace the negative emotions and consequently to reappraise them in a more favourable light. By distancing and embracing the range of emotions, this mechanism allows us to enjoy the overall experience

(Leddington, 2017; Menninghaus et al., 2017). Elaborating on this, Leddington takes it one step further by arguing that watching magic elicits an oscillation between the emotions of confusion and interest (Leddington, 2019, 2021).

Further insights on why we enjoy magic come from experienced magicians. For example, the influential magician Teller describes magic as "a form of theatre that depicts impossible events as though they were really happening" (Stromberg, 2012). Similarly, Darwin Ortiz has written extensively on magic theory, and states that magic is "about creating an illusion, the illusion of impossibility" (Ortiz, 2006). The imaginative magic creator, Simon Aronson, describes the magic experience as

> [the spectator] knows what has just happened, and yet also knows that it cannot happen, that it defies the controlling laws that govern our world. And yet, you did it. A magician's paramount goal is to manipulate the spectator's mind and senses to bring about this state of impossibility (Jay et al., 2013, p. 35).

Or as Leddington states it, "the distinctive aim of theatrical magic is to produce an experience as of an impossible event" and the value of understanding the magic experience is in its uniqueness from other arts as "a first step toward a general aesthetics of the impossible" (Leddington, 2016a, p. 254).

To date, very little empirical research has directly investigated the emotions that magic elicits or the psychological factors that modulate our enjoyment of magic. At the centre of this experience lies experiencing things that appear to be impossible. Neurological studies support this view and demonstrate that magic elicits neural activations in brain areas that are involved in experiencing and resolving cognitive conflicts (Danek et al., 2015; Parris et al., 2009), which lends support to importance of surprise in our enjoyment of magic. Griffiths (2015) has also shown that different types of magical transformations elicit more or less interest in the magical

effect, which suggests that our enjoyment of magic is directly related to internal world views. Curiosity arousing stimuli were also developed using ratings of surprise, interest, clarity of trick, and confidence in the trick's solution (Ozono et al., 2021). They found positive correlations amongst surprise, curiosity, and interest whereas all three were negatively correlated with confidence in solution (i.e. being less impossibility). These studies all point to magic eliciting emotions that promote knowledge exploration like surprise, curiosity and confusion (Vogl et al., 2020), which arise from an unexplainable moment of the impossible.

Taken altogether, an empirical investigation of magic enjoyment, first and foremost, ought to begin by examining its relationship with the perceived impossibility of magic performances. We set out to do so by utilising a magic trick that produces different degrees of "impossibility" within the same performance. We avoided magic tricks where the magic moment was a vanish, appearance, or transformation because these magic moments often occur quickly, without a gradual increase in impossibility. Furthermore, such effects make it difficult to define a baseline where the magician does something similar yet possible (see Parris et al., 2009). We therefore settled on a magic trick that involves balancing objects in ways that are possible, pseudo-possible, and impossible (Jay, 2018). This allows a very plausible baseline to be established, and the performance also grows progressively more impossible until it borders the resemblance of a completely impossible levitation. Furthermore, since humans have systematic balance estimation biases (Firestone & Keil, 2016), a balancing trick provides a better middle ground in spectators' possibility ratings, which avoids a saturation of extreme scores.

In the current study, we used this balancing trick to investigate the relationship between participant's enjoyment and perceived impossibility. We hypothesized that viewers will perceive the performance to be progressively more impossible as time goes on, and that impossibility

would be strongly correlated with enjoyment in the absence of other confounding entertainment factors. That is, more impossible moments would be more enjoyable and vice versa.

5.2 Methodology

5.2.1 Participants

Participants were 129 first-year Psychology undergraduate students attending a research methods lecture, where they were invited to take part in ongoing research studies within the psychology department. The average age was 20.0 (SD = 4.19) consisting of 106 women and 23 men. Students were rewarded with research participation credits that counted toward their final grade in the course. Goldsmiths Psychology Department provided ethical approval for the two experiments. All variables that have been collected are reported.

5.2.2 Procedure and magic performance

The magic trick was performed live at the front of a lecture hall for students who were directed to the online questionnaire before the performance began. The trick, *Balance*, was created by Joshua Jay (Jay, 2017, 2018) and involved the magician stacking numerous items to form an impossible balancing act (Figure 1). The trick used a bottle, a toothbrush, a pencil, an empty card box, an empty crayon box, and a blue crayon. All objects were first handed out to a few students for examination before the trick began. The performer maintained a neutral emotional expression throughout the performance and the script was limited to provide participants instructions about when to proceed to the next pages of the questionnaire. These instructions corresponded to the 7 timepoints of the magic performance that we measured their enjoyment and the perceived impossibility.

The performance began by balancing the objects in a plausible manner, such as balancing the pencil on its flat eraser end or creating a bridge from the objects. The balancing became progressively more impossible during each timepoint. The full progression of the

impossible balancing act is outlined in Figure 1. After the final timepoint rating, participants were asked to give an overall rating for how impossible and enjoyable the magic performance was.
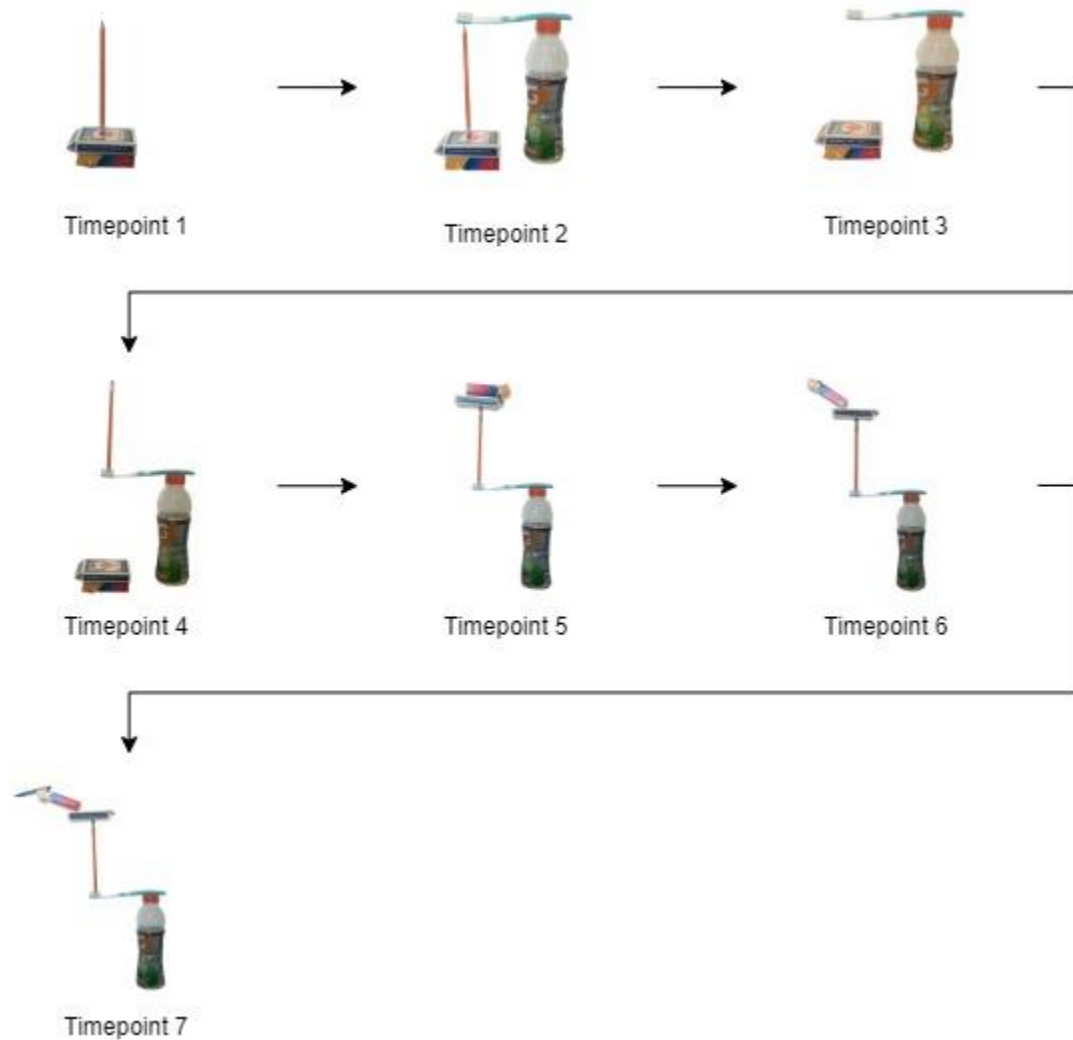
Figure 1. The seven timepoints of the balancing magic trick where impossibility and enjoyment measures were taken. Each timepoint reflects a stable, self-standing structure.

5.2.3 Measures of Enjoyment and Perceived Impossibility

The questionnaire was administered via Qualtrics online software. The students completed the questionnaire on their laptop or device of their choosing. All items utilized a continuous slider scale with values ranging from 0 to 100.

Before the performance, participants answered the question "How much do you enjoy watching magic tricks (i.e. tricks performed for entertainment)?", with scale labels ranging from "I do not enjoy watching magic tricks at all" to "I enjoy watching magic tricks more than anything else". This was used to ensure that their *Balance* enjoyment was not merely a bias of their general enjoyment of magic.

After observing each timepoint of the magic performance, participants answered two questions. To assess enjoyment, the questionnaire asked, "How much did you *enjoy* what you just saw?", with scale labels ranging from "I did not enjoy it at all" to "I enjoyed it immensely". To assess perceived impossibility, students were asked "How *impossible* was the thing you just saw?", with scale labels ranging from "Completely possible" to "Completely impossible". At the end of the performance, students answered "Overall, how much did you enjoy the entire demonstration?", and "Overall, how impossible was the entire demonstration?" with the same scale labels as the prior questions.

5.3 Results

This study aimed to investigate how perceived impossibility relates to audience's enjoyment of magic performances. Specifically, we evaluated the relationship between perceived impossibility and enjoyment, across 7 timepoints, during the performance of a balancing magic trick that gradually became more impossible as the performance progressed. To control for potential bias and confounds from participants general enjoyment of magic, we conducted a

regression predicting of the actual enjoyment of our live magic performance. All variables were assessed for normality via the values for skewness (absolute value less than 2) and kurtosis values (absolute value less than 7) as per Curran et al. (1996).

5.3.1 Enjoyment Impossibility Regression

The data for the regression did not meet the assumption of homoscedasticity, so we used the macro developed by Hayes & Cai (2007) for adjusted standard errors. Tolerance levels indicated no multi-collinearity. The regression indicated that the model was a significant predictor of *Balance* enjoyment, model R^2 = .309, $F(2, 125)$ = 27.376 (p < .0001). General enjoyment of magic was a significant predictor of *Balance* enjoyment (β = .424, t = 3.91, p < .0001) and overall impossibility of *Balance* was also significant (β = .327, t = 4.00, p < .0001).

5.3.2 Enjoyment and Impossibility correlation across time

The next analysis examined the relationship between perceived impossibility and enjoyment of the trick across the 7 time points (see Figure 2). Participants were excluded from data analyses if they failed at least one attention check, did not complete the questionnaire, or if the participant gave the same rating for all timepoints (i.e. undefined correlation coefficient). This resulted in 123 participants (102 female, 21 male) in the final sample for analysis with a mean age of 20.0 (SD = 4.19).

To analyse the progression of enjoyment and impossibility across time, two one-way within-subjects ANOVAs were conducted with a Huynh-Feldt correction. Enjoyment scores differed statistically significantly across timepoints, $F(3.45, 441.9)$ = 68.3, p < .001, partial η^2 = .348. Bonferroni corrected pairwise comparisons confirmed that both the first and second timepoints were significantly less enjoyable than all subsequent timepoints where the impossible moments had occurred (See Figure 2). After the first impossible moment occurred, enjoyment plateaued with no additional statistically significant results in post-hoc analyses.

Similar to enjoyment, impossibility ratings differed significantly across timepoints, F(3.26, 416.84) = 106.9, p < .001, partial η^2 = .455. Bonferroni corrected pairwise comparisons again confirmed that both the first and second timepoints were significantly less enjoyable than all subsequent timepoints. Unlike enjoyment, however, impossibility increased gradually as the performance continued, with both the first and second impossible moments (i.e. timepoint 3 and 4) scoring lower on impossibility than the two final timepoints (See Figure 2). Similarly, impossible timepoint 3 was significantly lower than timepoint 5, whereas neither of these timepoints were statistically different than timepoint 4. Numerical values of the means also indicated a gradual increase of impossibility.
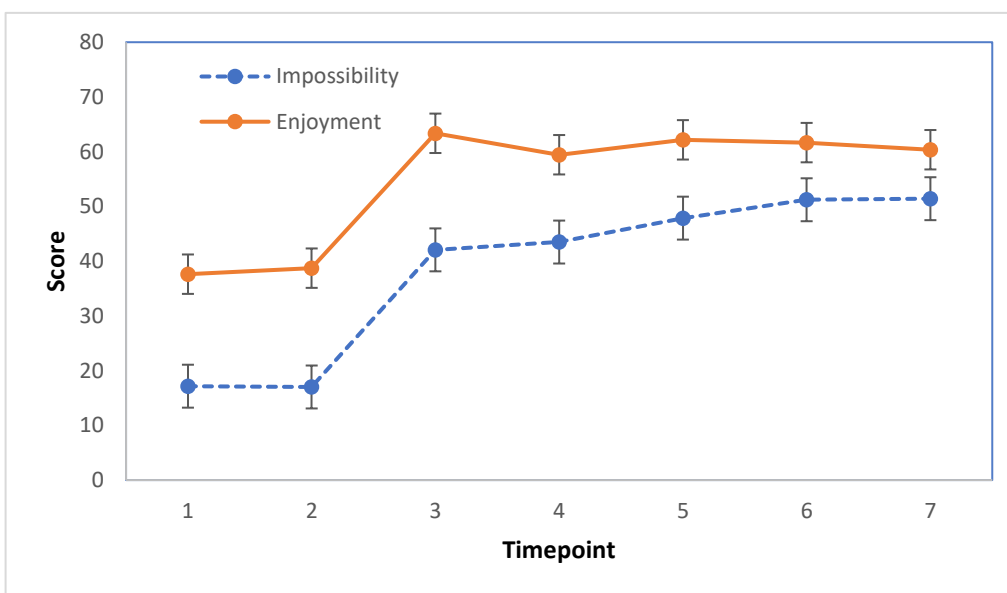
Figure 2. Mean impossibility and enjoyment scores across all seven timepoint of the magic performance. Timepoints 1 and 2 reflect the only timepoints where the balancing was reasonably possible.

Next, we examined the relationship between impossibility ratings and enjoyment over time. Pearson correlation coefficients were first calculated for each participant by using their scores at all seven timepoints. A one sample t-test showed that the mean correlation coefficients were significantly greater than zero (r_{mean} = .564, SD = 0.393, 95% CI [.493, .634]), *t(122)* = 15.83

, $p < .001$, cohen's $d = 1.43$, These results further illustrate a strong positive relationship between perceived impossibility and enjoyment.

5.4 Discussion

This study aimed to investigate the relationship between people's enjoyment and their perceived impossibility of magic. Our regression analysis shows that people's enjoyment of the magical effect relates to their perceived impossibility of the magic trick, and this relationship was independent of how much they enjoyed magic in general. Moreover, our correlational analysis showed that participants enjoyed the performance more as it became more impossible.

However, this correlation was not perfect. After the first impossible moment had occurred, enjoyment plateaued whereas perceived impossibility continued to increase as additional objects were added to the impossibly balanced structure. At first, it may appear perplexing why enjoyment levels off if perceived impossibility continues to increase. However, we believe that this occurs because most of the enjoyment arises from the *unexpected surprise* of witnessing an impossible moment. In our case, enjoyment was predominantly derived from the *first* impossible balancing moment. Once these impossible balancing acts were anticipated, subsequent repetitions with other objects are less surprising and enjoyment does not increase further, despite the structure becoming more impossible. Indeed, a previous questionnaire-based study showed that people particularly appreciate the element of surprise that magic offers (Jay, 2016). Moreover, preliminary data from our own lab shows that people rate surprise as the most important emotion when asked to identify the emotions that magic elicits.

Our study is unique in that it allows us to examine participants' enjoyment of the trick as the performance unfolds. It is likely that the spectator begins rationalising how the first impossible moment occurred. As time progresses, the spectator has more time to rationalise

and as they persistently fail to find an adequate explanation, their impossibility evaluation increases. This effect is strengthened by adding more impossibly balanced objects, which occur at a faster rate than the spectator can generate adequate explanations. This results in a cognitive overload and ultimately higher impossibility ratings. Lastly, it is also worth noting that timepoint 4 (pencil stabbed into the bristles of toothbrush) can very well be perceived as possible. This explains why no impossibility increase was observed in post-hoc tests between timepoint 3 and timepoint 4.

Magic allows us to witness the impossible and our results illustrate that people enjoy this sense of impossibility. These results align with some of the theoretical works on magic that discuss the experience of magic as a predominantly intellectual rather than emotional experience. This intellectual aspect also implies that epistemic emotions like surprise, confusion or curiosity (Vogl et al., 2020) would be paramount when watching magic.   Along these lines, Kuhn (2019) has suggested that our enjoyment of magic results from an inherent drive towards exploring things that validate our understanding of the world. Infants are captivated by events that violate their understanding of the world, and it's been suggested that our attraction and enjoyment of magic may result from this captivation of the impossible (Harris, 1994). Lewry et al. (2021), have reported a negative correlation between adult's interest in different types of magical transformation and the age in infancy at which they learned that the transformations violated their understanding of the world. These results point towards a link between interest in magic and the strength of our beliefs that such transformations are impossible. Moreover, Medeirose et al. (2021) have recently examined some of the attributes that people particularly enjoy about magic. To do so, they asked people to describe the things that they enjoyed about magic. One of the most common themes to emerge from this analysis was violations in the laws of nature – in other words experiencing things that appear impossible.   These results add further weight to the

argument that our enjoyment of magic directly results from experiencing things we believe to be impossible.

The art of magic has a wide range of genres, and they all vary in the type of effect performed (e.g. vanish, transformation), in the context in which they are performed (e.g. stage, close up, mental), and in the style in which they are performed (e.g. comedy, bizarre, spectacle). We chose a magic trick that was devoid of any specific performance genre, in the hope of capturing the essence that appears central to all magic – experiencing the impossible. That said, there are obvious limitations in focusing on one single piece of magic, as this limits the extent our results generalize to other performances. Most past research that has examined the emotions that magic elicits has done so by asking participants to watch a range of different magic tricks (Danek et al., 2014, 2015; Ozono et al., 2021; Parris et al., 2009). There is an inherent advantage in doing so, but in each of these studies, the tricks were performed by a limited number of performers, and they were all performed in the same style. Further research may try to examine whether our findings generalize to other types of magic performances.

Another limitation might be how participants perceived the word "enjoyment", since magic operates more on the intellectual side (Leddington, 2016a) and thus, engagement may be more akin to an intellectually challenging flow-like experience, whereas "enjoyment" may have been interpreted more like a joyous happiness. To address the broad interpretations of "enjoyment", one approach would be for future studies to investigate a more comprehensive list of emotions to better understand the emotional fingerprint of the magic experience. This would help clarify which emotions are most important to the experience. Considering the visual nature of magic tricks, the 27 emotions elicited by videos in Cowen and Keltner's research (2017) would be appropriate.   Some of these emotions might be surprise, confusion, curiosity, and wonder. In psychology, wonder is typically used interchangeably with awe, and like magic, one feature of awe is a need for cognitive closure (Keltner & Haidt, 2003; Yaden et al., 2018). Thus,

measuring awe in more detail during the magic experience would likely provide deeper insights into the magic experience. Similarly, curiosity would be worth investigating further because while an experience of awe is independent of whether the cognitive conflict is resolved, feeling curious (or confused) implies that the conflict remains unresolved, as is the case in magic.

In regards to curiosity, it would also be helpful to understand how individual differences in curious types of people relate to enjoyment, considering there appear to be multiple dimensions of curiosity (Kashdan et al., 2018, 2020). Other individual differences worth exploring would be Big-5 personality traits to learn how broad the appeal of magic is. Individual differences in locus of control would help us learn whether the knowingly deceptive nature of magic relates to individuals' beliefs about how much of the outside world is within their control. The latter would be particularly revealing for helping explain part of why learning magic led to increased feelings of mastery in prior work (Bagienski et al., 2021) as measured by one's beliefs about personal control of life outcomes.

Future work aimed at understanding or improving magic performances can focus on several different areas. Research on dialectical thinking (e.g. Hui et al., 2009; Kitayama et al., 2010; Miyamoto & Ryff, 2011; Shiota et al., 2010), or the tendency to accept contradictory thoughts and emotions, would be relevant to the enjoyment of negative emotions in magic (Leddington, 2017) with individual differences yielding valuable insights into how audiences enjoy magic. There is also room for developing an impossibility measure by asking participants directly about the cognitive conflict in magic (i.e. magic tricks are perceived as both possible and impossible). Further exploration into the role of *unexpected* surprise may also prove fruitful. For example, future experiments could investigate how enjoyment is affected by the number of unexpected impossible moments within a performance or by whether or not an impossible moment was anticipated. A vast number of such moments within the same performance may

be especially relevant to Awe since vastness has been a common theme in research on awe (Keltner & Haidt, 2003; Yaden et al., 2018).

In summary, the present study was the first to empirically show a relationship between impossibility and enjoyment of a magic performance, where higher perceived impossibility correlated with enjoyment. However, it appears that once the magical effect is anticipated, enjoyment begins to plateau while perceived impossibility can continue to increase. Therefore, we believe surprise of an unexpected, impossible moment to be driving the enjoyment in magic. Future research will help us gain a richer understanding of this unique aesthetic experience of the impossible. In doing so, new methods can ultimately be developed that more easily inspire the underlying beliefs and mindsets that make the impossible challenges of today become the new reality of tomorrow.

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Chapter 6: The magic personality: Do individual differences in Big 5 personality traits and locus of control predict magic trick enjoyment?

Abstract:

Enjoyment of impossibility in magic performances is shaped by a variety of factors, one of which could be individual differences in an individual's personality. Understanding such differences would be helpful in tailoring magic-based wellbeing interventions. Magicians often describe the different ways that different audience members react to magic, but thus far there has been limited empirical research. Furthermore, locus of control may be relevant since enjoying magic performances requires the audience to give the performer a certain level of control, which may be more apparent than other artforms due to its associations with impossibility and deception. Thus, we investigated whether the Big-5 personality traits and locus of control predict general magic enjoyment and magic enjoyment from not knowing secrets. Results from combining two student samples suggested that extraversion and internal locus of control significantly predicted magic enjoyment, whereas external locus of control from powerful others predicted enjoyment of not knowing. These results, however, should be treated with caution due to cohort differences and the lack of replication in the individual samples. While extraversion had a slightly larger effect, the findings may simply imply that these individual differences are minor and that magic can be universally enjoyed. [9]

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[9] This chapter has not yet been submitted to an academic journal for publication.

Introduction

As shown in Chapter 5, an audience's perceived impossibility has a strong impact on how much they enjoy magic tricks. However, perceived impossibility only accounted for less than 30.9% of people's enjoyment of the trick, which implies that other factors influence the extent to which people enjoy magic. Our enjoyment of this impossibility is shaped by a variety of factors, such as the performance style, the presentation quality, and an individual's prior experiences with magic, as well as individual differences in personality. Some factors especially important to wellbeing applications would be how individual differences that predict magic enjoyment. In this chapter, we try to identify some individual differences that might predict people's general enjoyment of magic. For example, as highlighted in Chapter 5, the positive social reaction to watching magic helps validate participants' successful experience of mastery when learning to perform magic. Therefore, the individuals who enjoy magic most are also the ones more likely to provide this social validation through their emotional response to the magic trick. More generally, by understanding the common characteristics of these individuals, group magic interventions can be tailored to have the right mix of people and be better designed to have maximal impact.

Determining common, underlying characteristics of people who enjoy magic is challenging and may relate to individual differences in their social behaviours, curiosity, inclination for live entertainment, comfort with embracing mental conflicts and so on. To get a broader understanding, however, perhaps the ideal approach is to simply look at how magic enjoyment relates to more established personality constructs. To date there has been very little research examining individual differences in how people enjoy magic tricks, and the Big-5 structure of personality (Costa & McCrae, 1992) is a useful starting point. The Big-

5's factor of Openness to Experience has successfully predicted arts preferences of paintings in a previous study (Chamorro-Premuzic et al., 2009), and there are several reasons why this personality trait could be relevant to magic too. People scoring high on the extraversion dimension will likely react to magic tricks with more overt enthusiasm and surprise. When paired with the interest or curiosity elicited by magic, this enthusiasm may very well promote positive relationship building as postulated elsewhere (See Bagienski & Kuhn, 2019 pp 32). As a result, we predict that extraverts will enjoy magic more than introverts. Individuals scoring higher on agreeableness may be more easily deceived by the tricks, which could increase their perceptions of the impossible. Since our prior findings showed a positive correlation between perceived impossibility and enjoyment, we therefore predict a positive relationship between agreeableness and enjoyment. Higher scores on openness may lead to an increased willingness to embrace the mental conflict that magic creates between what we perceive and what we know is possible (Leddington, 2016), and thus we predict that individuals with higher levels of openness will enjoy magic more. On the other hand, conscientiousness could decrease enjoyment because highly conscientious individuals may neatly organize their perceptual experiences into a coherent plan that explains the secret behind the magic. Lastly, neuroticism may be linked to low enjoyment by causing a highly neurotic individual to worry about the magician using their skills of deception for malevolent purposes.

To date, there are no established scales that measure the enjoyment of magic, but interestingly a "loathing of legerdemain" measure has recently been developed (Silvia et al., 2020)[10]. The scale measures dislike of magic, which was associated with lower openness to experience and low agreeableness but no consistent relationships for other Big-5 traits. Disliking magic was also associated with lower awe-proneness, higher dogmatism, intolerance of uncertainty, personal need for structure, greater interpersonal dominance,

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[10] The Loathing of Legerdemain scale was not used in othe present study because it was published after we had completed data collection.

higher psychopath, and lower faith in humanity. The absence of loathing does not necessarily imply enjoyment, but these findings nevertheless hint at enjoyment being associated with higher openness and higher agreeableness.

As speculated above for neuroticism, the ethical perception of the deception used in magic may also be relevant and manifest itself in locus of control individual differences. The magician as a powerful external figure has been discussed by Nardi (1988), who argues that this perception is partly due to 1) the relinquishment of control in a performing context, and 2) magic being male dominated with sociocultural gender roles reinforcing men as the powerful leader in control. Furthermore, in Chapter 4, we observed that people overestimate the difficulty of performing certain magic, which may further reinforce the idea that the magician has a great deal of power to manipulate, since after all he was capable of mastering this "impossible" and deceptive power. As a result, this power would likely be salient for individuals with a higher external locus of control. For some, this could feel threatening and imply that they have less personal control. Historically, there is also some truth to these concerns as magicians have often been in conflict with fraudulent faith healers, psychics, and mediums (Pankratz, 1987) and since both appear similar at first glance, the lay public will have difficulty distinguishing an honest magician from manipulative charlatans. On the other hand, magicians often perform things that are impossible, or at the very least extremely unlikely. For example, in gambling demonstrations events occur that are extremely unlikely to occur by chance. Thus, when the magician demonstrates repeated successes of winning highly improbable scenarios, an external locus of control due to luck might increase enjoyment by allowing audiences to imagine this excitement without risking any actual money. One study found that the objective probability is related to magic enjoyment, even when the odds are as high as a twenty five percent chance (Kuhn, Pailhès, Lukian & Jay, 2021). In summary, the enjoyment of magic regarding locus of control may be affected by these ethical grey areas and by the imagined excitement of gambling wins.

There is a generally agreement amongst magicians that people respond differently to magic tricks and some magicians have specifically commented on specific personality traits that may affect the way people enjoy magic. For example, Jay Sankey put forward an account that resembles the psychological constructs in the Big-5 and locus of control (2003, pp. 81–87). Sankey describes a list of "classic" audience members and explains how each would enjoy magic differently. The first is what he calls "The Shy Person", and he suggests that this person prefers watching magic at a distance with little involvement, which nicely mirrors highly introverted individuals. On the other extreme, Sankey describes "Mr. Loud", who constantly wants to be involved so he can feel more in control. This character can be thought of as an extraverted individual with a low internal locus of control. Sankey goes on to describe the "Know-it-all" who has a need to explain every trick as if it were a puzzle. He argues that this arises from feeling intellectually challenged, which might reflect individuals who score low on agreeableness. He suggests that most of these characters arise from feeling a loss of control, which neatly dovetails the psychological construct of locus of control. In extreme cases, this loss of control is exhibited as rudeness from an audience member, which is created from a perception that the magician is arrogant, such as using his powerful demonstrations to show off (Sankey, 2003, p. 85). These observations from the magic community further suggest that magic enjoyment would be affected by the Big-5 personality traits and individual differences in locus of control.

To date, there is no universally accepted measure of how much people enjoy magic. The most direct way of measuring enjoyment has been simply asking people to rate the extent to which they enjoy watching magic (Danek et al., 2014; Kuhn & Jay, 2021; Medeiros et al., 2021; Pailhès et al., 2021). However, such unidimensional measures may not necessarily capture the true nature of the magic experience. One of the challenges in measuring magic enjoyment results from the dual conflict that magic creates. Leddington (2016) describes the magic experience as knowing that the magic is fake, but at the same time we cannot provide any explanation for why it is fake, and thus our perceptual

experience tells us that the magic is real. This dual nature of the magic experience makes it difficult to tease out enjoyment due to knowing that magic is fake (similar to fiction) versus enjoyment due to the very real perception that the magic occurred. In this experiment we tried to tease apart these two component by asking participants how much they enjoy watching magic as well as how much they enjoy *not knowing* the secrets.

Measuring enjoyment from not knowing secrets also appears to have some empirical support. In one experiment, participants were given the opportunity to either discover the secret or watch another trick, and they found that sixty percent preferred watching another trick. Work from Medeiros et al. (2021) also showed that some people enjoy not knowing the secrets and others enjoy trying to figure out the secrets, suggesting that there may be individual differences in how people enjoy not knowing the secrets to magic.

We set out to explore these questions in the current study by measuring individual's enjoyment of magic and their individual differences. We used the Big 5 personality traits, internal locus of control, and external loci of control related to powerful others and chance(Levenson, 1973). For general enjoyment of magic, we predict 1) positive correlations with extraversion, agreeableness, openness, chance locus of control, and internal locus of control, and 2) negative correlations to conscientiousness, neuroticism, and powerful others locus of control. Since not knowing secrets is presumably the most common occurrence in magic, we predict the same relationships for enjoyment of not knowing secrets.

Methodology

Participants

Participants were all first-year Psychology undergraduate students attending a research methods lecture, where they were invited to take part in ongoing research studies within the

psychology department. Students were rewarded with research participation credits that counted toward their final grade in the course.

A pilot was initially conducted with the first cohort of 183 students whose age and gender were not recorded due to a questionnaire error. One year later, we took the same measures for the new cohort, which consisted of 185 students (152 women, 32 men, 1 undisclosed) with a mean age of 20.1 (SD = 4.91). Participants were excluded if they provided incomplete data for at least one construct, or if they failed one or more attention check. Attention checks were only present for the second cohort's questionnaire.

Procedure and magic performance

The questionnaire began by asking students "How much do you enjoy watching magic tricks (i.e. tricks performed for entertainment)?" followed by "When watching magic tricks, how much do you enjoy the feeling of "not knowing" the secret to how it's done?". Both items utilized a continuous slider scale, ranging from 0 to 100. Afterwards, the students completed the Big-5 and locus of control measures. The entire questionnaire was administered via Qualtrics online software and students were directed to complete it on their laptop or device of their choosing during their lecture time.

Measures of Big-5 and Locus of control

For measuring the Big-5 personality traits, we used the short Big Five Inventory of personality dimensions (Lang et al., 2011). Items were listed in the order presented in Lang et al.'s (2011) original paper, and without randomization on the basis of research indicating negligible order effects for personality measurements (Schell & Oswald, 2013). While the initial version of this scale was administered in German, the factor structure has been replicated in both German and English samples with sufficient reliability and validity (Rammstedt & John, 2007). For the pilot cohort, reliability assessed by Cronbach alpha was acceptable (i.e. above 0.7; Nunnally

& Bernstein, 1994)) for all the Big-5 items except for agreeableness (Cronbach alpha = .468) and conscientiousness (Cronbach alpha = .522). For the second cohort, reliability assessed by Cronbach alpha was good for all but openness (Cronbach alpha = .573), agreeableness (Cronbach alpha = .507) and conscientiousness (Cronbach alpha = .510).

For locus of control, we used Levenson's (1973) three factor locus of control scale. Two factors measure external locus of control, and one factor measures internal locus of control. The external factors reflect beliefs about the influence powerful others have on one's life outcomes, whereas the second external factor reflects beliefs on how fate, chance, or luck affect personal outcomes. For the pilot cohort, reliability assessed by Cronbach alpha was good (above 0.7) for all items except for internal locus of control (Cronbach alpha = .496). For the second cohort, reliability was acceptable for the factors of chance (Cronbach alpha = .685) and powerful others (Cronbach alpha = .698) but not for internal locus of control (Cronbach alpha = .372).

Results

After removing participants who failed to meet inclusion criteria, the combined sample contained 304 participants (177 from the first cohort and 127 from the second cohort). The regression aimed to predict general enjoyment and enjoyment of not knowing the secrets by using the Big-5 and locus of control measures as predictors. All variables were normally distributed as assessed by values for skewness (absolute value less than 2) and kurtosis values (absolute value less than 7) as per Curran et al. (1996). Tolerance levels for all regressions indicated no multi-collinearity was present.

General enjoyment of magic

We first decided to run the regression combining samples for increased statistical power. In this case, the regression model of general enjoyment was significant, model $R^2 =$

.066, $F(8, 295) = 2.60$, $p < .01$. The significant predictors were extraversion ($\beta = 0.13$, $t = 2.18$, $p = .03$) and internal locus of control ($\beta = 0.13$, $t = 2.13$, $p = .034$).   Next, we analyzed the two cohorts individually because 1) we observed cohort differences on measures of internal locus of control, $t(302) = 2.34$, $p = .018$ and 2) attention checks were only used for the second cohort, which may have resulted in noisier data for the first cohort.

For general enjoyment in the first cohort, the regression model was not significant, model $R^2 = .06$, $F(8, 168) = 1.28$, $p = .26$). While the overall model was not significant, neuroticism ($\beta = 0.19$, $t = 2.22$, $p = .028$) and extraversion ($\beta = 0.16$, $t = 1.98$, $p = .049$) came out as significant predictors. We acknowledge that this outcome of having significant beta weights when the model R^2 is not significant is less common in psychology and should be treated with caution, but from a statistics standpoint they can nevertheless still be interpreted. While the beta coefficients still indicate a significant trend at a macroscopic level (namely that on *average* the dependent variable increases for each unit increase of the independent variable), the low model R^2 indicates that the *variability* around the regression line is rather very high (see Frost, 2018). In short, the data was scattered but still displayed an overall correlation between general enjoyment and both neuroticism and extraversion.

For general enjoyment in the second cohort, the data were not homoscedastic so we used the macro developed by Hayes & Cai (2007) for adjusted standard errors. The regression was a significant predictor of general enjoyment, model $R^2 = .17$, $F(8, 118) = 2.96$, $p = .005$. The only significant predictors were chance locus of control (b = 1.35, $t = 2.73$, $p = .007$) and internal locus of control (β b = 0.74, $t = 2.00$, $p = .047$).

Not knowing enjoyment

We also analysed how much participants enjoy "not knowing" how magic is done. The regression was conducted first by combining the samples for increased statistical power.   In this case, the regression model of "not knowing" enjoyment was not significant, model $R^2 = .033$, $F(8, 295) = 1.26$, $p = .26$). The only significant predictor was powerful others locus of

control (β = -0.14, t = 2.03, p = .043). However, it's worth noting that chance locus of control was a borderline nonsignificant predictor (β = 0.13, t = 1.86, p = .06). Enjoyment of not knowing was also significantly correlated with general magic enjoyment r(302) = 0.23, p < .01.

As before, we next analyzed the cohorts separately due to cohort differences. In the first cohort, the regression model was not a significant predictor of "not knowing" enjoyment, model R^2 = .036, F(8, 168) = 1.83, p = .07. While the model was not significant, powerful others locus of control (β = -0.19, t = 2.22, p = .028) came out as a significant predictor.

For the second cohort, the regression for "not knowing" enjoyment was significant, model R^2 = .212, F(8, 118) = 3.96, p < .001. Both agreeableness (β = 0.24, t = 2.68, p = .008) and chance locus of control (β = 1.95, t = 3.17, p < .001) were significant predictors.

Discussion

General enjoyment of magic

Our aim was to determine whether individual differences in big-5 personality traits and locus of control would predict people's enjoyment of magic. Regression analysis from the combined sample showed that extraversion and internal locus of control significantly predicted general magic enjoyment. The regression for enjoyment of not knowing secrets was not significant, even though the beta coefficients were significant for powerful others locus of control. However, these results should be treated with caution due to the lack of replication and the cohort differences we observed. This is not surprising considering the strong relationship between extraversion and happiness or subjective wellbeing (Pavot et al., 1990). Therefore, if extraverts generally experience positive affect more frequently, then it makes sense for this relationship to carry over when enjoying a magic performance. In addition, this finding may also reflect common social reactions inspired by magic. As discussed by Bagienski and Kuhn (2019), the social experience of magic may induce a

socioemotional mirroring process where positive emotions are built up by transferring them back and forth between the magician and spectator. It was theorized that this would be especially true for smaller audiences where magic tricks are experienced up-close and eye contact is easily made to initiate the mirroring process. This process would be greatly facilitated by extraverts simply because they are more openly expressive of their emotions. As a result, extraverts may frequently enjoy this accumulation of positive emotions whereas introverts only experience it indirectly by observing the more extraverted spectators.

On the contrary, Silvia et al.'s (2020) study also showed a positive correlation between extraversion and hating magic. This provides evidence that enjoying magic is not merely the absence of disliking magic and thus further studies ought to take this into consideration. While further research is needed, this may simply reflect the dual nature of magic to elicit both unpleasant confusing emotions and more pleasant emotions of interest or curiosity (Leddington, 2019).

The remaining aspects of general magic enjoyment are difficult to discern from our results, but internal locus of control might be the next most likely predictor. The major limitation was the internal consistency for our measures. In both cohorts, Cronbach alpha was poor for agreeableness, conscientiousness, and internal locus of control. As a result, this led to rather noisy data, especially for the first cohort as reflected by the low R squared values. This could partly be due to the lack of attention check items, which were only utilized in the second cohort. The internal consistency for openness in the second cohort was also low, thus limiting our ability to produce accurate regression models regarding these four factors. Despite this limitation, however, internal locus of control still came out as a significant predictor in the combined cohort. While neuroticism also came out as significant in the first cohort, this effect did not replicate in the second cohort despite its acceptable Cronbach alpha values. Along with the non-significant R squared values, this lends further evidence that our first cohort contained more noisy data and thus, we believe less weight of evidence should be given to results in the first cohort.

The theoretical case for internal locus of control is also stronger than it is neuroticism. Someone who scores high on internal locus of control would feel more secure with what they can control and thus be less apprehensive about a powerful magician using his skills for malevolent purposes. For this same reason we expect neuroticism to have a negative correlation to enjoyment, but this was opposite of what was observed in the noisy data from the first cohort. An argument could be made that magic tricks reassure highly neurotic people by implying that their unfulfilled, "impossible" desires become possible through the performance, but this argument does not hold up well if a premise of the magic trick experience is knowing that the magic is fake. Furthermore, Silvia et al.'s (2020) study showed a small but positive correlation between neuroticism and *loathing* of magic tricks. While further testing is clearly required, we believe that internal locus of control would be a more likely predictor of magic enjoyment than neuroticism due to both the noisy data and the stronger theoretical rationale.

Interestingly, locus of control due to chance was only a significant predictor for the second cohort. This was true for both general enjoyment and enjoyment of not knowing the secrets to magic, which seems to indicate that the second cohort derived a lot of enjoyment from not knowing the secrets. A moderating effect of internal locus of control might be present since the second cohort scored significantly lower on internal locus of control than our first cohort. A lower internal locus of control means the individual would need to rationalise outcomes as occurring due to external factors like chance, and hence already be comfortable with this fact. As a result, they are more likely to enjoy the uncertainty of not knowing the secrets, compared to an individual who is accustomed to being in control.

Not knowing enjoyment

Powerful others locus of control was also a consistent negative predictor of "not knowing" enjoyment across the first and combined samples. These results are in line with the theoretical rationale of feeling threatened by the potential for a magician to use his skills of

deception for malevolent purposes. The uncertainty of not knowing his secrets could amplify this threatening feeling, especially if an individual believes a powerful magician figure has control over their personal outcomes in life.

Regarding enjoyment of not knowing the secret, results were again mixed across samples for the remaining factors. For the second cohort, agreeableness, and locus of control due to chance both positively predicted "not knowing" enjoyment. The case for agreeableness seems stronger since it was a significant predictor despite its low internal consistency. Furthermore, these results mirror the flip side of Silvia et al.'s work (2020) where low agreeableness was associated with loathing of magic. Agreeableness also has a sound theoretical rationale as more agreeable people would be more likely to accept the false causations given by the magician, experience more impossibility and hence enjoy not knowing the secrets. While theoretical rationales can be made for chance, the lack of replicability, despite acceptable internal consistency makes it difficult to assert any firm conclusions without gathering more data.

Overall, these results could alternatively depict that watching magic is universally enjoyed regarding personality and individual differences of locus of control.   That said, our study had its limitations. The poor internal consistency makes it difficult to come to any firm conclusions and further studies would benefit from more reliable measures of Big-5 personality traits, with more than three items per dimension. Our enjoyment measures were also limited to a single item, preventing us from knowing its reliability and validity. Future work can improve this by developing a scale that can capture the complex aesthetic enjoyment of the magic experience. It is also worth comparing magic enjoyment to a suitable control so we can determine whether the extraversion relationship is something unique to magic. Following this up, studies could specifically focus on the socioemotional contagion with highly extraverted people compared to highly introverted people. These results would provide clear guidelines on whether to intentionally include extraverts into group magic interventions because it may be helpful for enhance social validation of a

successful performance through the extravert's emotionally expressive, enthusiastic reaction.

In conclusion, we found that extraversion and internal locus of control predicted general enjoyment of magic tricks whereas powerful others locus of control negatively predicted enjoyment of not knowing the secrets in magic. Further research is needed to clarify other relationships to magic enjoyment but based on our available evidence magic may be universally enjoyed irrespective of personality. Future research would benefit from developing magic enjoyment scales and utilizing better measures to capture individual differences in how different types of people enjoy this timeless artform of magic.

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Chapter 7: Curiously Impossible: Personality differences in curiosity predict magic enjoyment across varying degrees of secrecy

Abstract

The alluring secrets of the impossible have piqued people's curiosity for ages, yet little is known about how individual differences affect the different ways in which different people become curious. Psychology is now at a point where we can begin answering such questions and the performance art of magic provides an ideal activity to investigate curiosity. Secrets are a crucial component for eliciting curiosity in the art of magic, and thus a better understanding is needed of how secrets mediate magic enjoyment. We conducted a structural equation modelling study that aims to predict people's enjoyment of magic across varying degrees of secrecy by using curiosity dimension as exogenous variables. We found that thrill seeking curiosity predicts enjoyment of never knowing secrets and deprivation sensitivity curiosity predicts enjoyment of confidently figuring out magic secrets. Moreover, enjoyment of figuring out secrets was predicted by enjoyment of already knowing the secret, which may reflect that knowing a secret in advance is viewed as an appreciated "hint" in figuring out the precise part of the live performance in which it was used. Both never knowing secrets and confidently figuring out the secrets predicted people's general enjoyment of magic. [11]

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[11] This chapter has been prepared for publication in an academic journal. At the time of this writing, it is not submitted for publication to a journal.

7.1 Introduction

The alluring secrets of the impossible inspire curiosity in different ways for different people. While curiosity has been investigated in psychology for more than a century (James, 1890), the literature has expanded over the years to include many branches of what it means to be curious. Only recently have advances been made in consolidating this literature into pragmatic tools to help researchers further explore the benefits of the different ways in which people are curious (Kashdan et al., 2018, 2020). In general, curiosity's function is to embrace new experiences, acquire new knowledge, and strengthen knowledge or competencies over time (Fredrickson, 2004; Kashdan et al., 2018). The implications of understanding *how* people are curious would be far-reaching. For example, curious people seem to be highly interested in the world as displayed by asking more questions (Peters, 1978), reading to learn more deeply (Schiefele, 1999), persisting in the face of challenges (Sansone & Smith, 2000), and learning how people think, feel and behave (Renner, 2006). Furthermore, Kashdan et al.'s (2018) study found that stress tolerance curiosity was the dimension of curiosity with the strongest correlations to measures of wellbeing.

The revised five-dimensional scale of curiosity (Kashdan et al., 2018, 2020) has now brought the field of psychology to a point where we can adequately measure individual differences in curiosity. This robust scale was created by consolidating different branches of the curiosity literature, which gives researchers a wholistic view when measuring curiosity traits. While great advances have been made in measuring and understanding curiosity, much less empirical research exists on how curiosity-arousing activities can be implemented for wellbeing interventions. Thus, the timing is opportune to begin exploring such activities.

One of the most powerful activities that can create a strong feeling of curiosity is the performance art of magic. Witnessing a magic trick is thought to result in a cognitive conflict between perceiving something as impossible and knowing that our perception is false, yet

lacking any evidence to explain this conflict (Kuhn, 2019; Lamont, 2013; Leddington, 2016a). As a result, this can yield an intense feeling of curiosity as the magician provides ample counterevidence for all rational explanations that a spectator can surmise (Leddington, 2016b). This intense curiosity is one of the core emotions that likely plays a role in our enjoyment of magic. Therefore, individual differences in curiosity could have much more explanatory power in people's enjoyment of magic, compared to the Big-5 traits or locus of control that was measured in the prior chapter.

To date, very little empirical research has directly investigated why we enjoy magic. However, Silvia et al. (2020) investigated why certain types of people may loathe magic. They found that *disliking* magic was associated with socially aversive traits and a lower propensity for curiosity and awe. Without dismissing the view that loathing and enjoyment are different constructs, these findings nevertheless imply that enjoyment of magic should at least interact with one's propensity for awe and curiosity. Thus, the current study aims to build on this work by directly investigating how individual differences in curiosity relate to enjoyment of magic.

Magic tricks have also been used to create curiosity arousing stimuli (Ozono et al., 2021) and one experiment showed this curiosity to be so intense that it was comparable to hunger (Vogl et al., 2020). This aligns with philosophical accounts of the magic experience (Bagienski et al., 2021; Leddington, 2016a), where the goal of a magician is to induce wonder by creating illusions of the impossible. In fact, the word impossibility itself implies something that does not exist and is thus novel by definition. This novelty is precisely what the characteristic curious person would enjoy. They would seek out novel experiences (like magic), strive to understand them, and perhaps gain a sense of joy or fulfilment in doing so.

Using Kashdan et al.'s (2020) revised five dimensional curiosity scale to predict people's enjoyment of magic would yield valuable insights at both applied and theoretical levels. Firstly, it could inform clinical applications by helping us understand which type of populations would be most suitable for curiosity-based interventions (e.g. distraction

therapies, see Bagienski & Kuhn, 2019; Labrocca & Piacentini, 2015; Peretz & Gluck, 2005; Vagnoli et al., 2005). Complementing this, empirical insights would also help us better understand potential barriers to enhancing an individual's curiosity.

On a theoretical level, research would also aid our psychological understanding of wonder. Psychology often uses wonder alongside the experience of awe (Anderson et al., 2019; Silvia et al., 2020) but in many cases wonder seems more reflective of curiosity. The reality is likely a combination of the two as described by Bagienski and Kuhn (2019) in which I postulate wonder as a combination of curiosity and awe. This is supported by observations of emotional gradients between awe and curiosity, and by more recent research, which shows that awe-prone people are also more curious (Anderson et al., 2019). Thus, understanding individual differences in curiosity will contribute more broadly to the scientific study of wonder.

In doing so, the secrets involved in magic are an important consideration. Magic enjoyment relies on withholding secrets because without them, the experience of wonder would vanish. This is the reasoning behind the cardinal rule of all major magician societies to never reveal the trick's secret (*The International Brotherhood of Magicians*, 2019; *The Society of American Magicians*, 2019). Therefore, we anticipate the spectator's knowledge of the secrets to mediate the relationship between curiosity dimensions and magic enjoyment. Even an incorrect guess may spoil the experience if the spectator is confident in the solution (Leddington, 2016a; Thomas et al., 2018) and it is therefore important to measure enjoyment under the conditions of whether the spectator knows the secret, figures out the secret, or never figures out the secret to the trick.

In this study, we set out to determine these relationships by measuring people's overall enjoyment, their enjoyment based on the degree of secrecy, and their individual differences in curiosity. We predict that general magic enjoyment (E_{gen}) will be most positively associated with enjoyment from never knowing how the magic trick works (E_{nk}), followed by enjoyment from confidently figuring out the magic trick (E_{fig}). We predict no

association between general magic enjoyment and already knowing how the magic trick

works (E_{ak}). Furthermore, we hypothesize the below relationships regarding dimensions

from the revised five-dimensional curiosity scale.

7.1.1 Hypotheses for curiosity dimensions

We present here our preliminary hypotheses on the relationships between curiosity

dimensions (Kashdan et al., 2020) and enjoyment of magic. The revised five-dimensional

curiosity scale contains six dimensions of curiosity (two within social curiosity). The

dimensions are joyous exploration, deprivation sensitivity, stress tolerance, thrill seeking,

general social curiosity, and covert social curiosity. In the initial paper, the authors describe

four "types" of curious people but for the sake of completeness we list predictions based on

each individual dimension. The below hypotheses for general magic enjoyment and the

three levels of secrecy are highlighted in Figure 1.

Joyous exploration is the curiosity dimension that describes people who have many

interests and view challenges as an opportunity to learn and grow. Therefore, the challenge

of knowing the secret to magic would be viewed as an opportunity to learn and hence

enjoyed most for people scoring high on joyous exploration. Never knowing the secret gives

this person a broad, unlimited range of ideas to explore and hence they enjoy magic most

when they do not figure it out. As the degree of secrecy fades, we predict enjoyment would

decrease, but only slightly, because successfully figuring out the secret would still increase

their knowledge and hence retain some enjoyment. Similarly, if they already know the secret

then enjoyment is limited to knowledge arising from how secrets are combined with other

performance aspects, such as jokes, stories, and showmanship.

Covert social curiosity describes people who enjoy gossip and seek information

regarding other people's private lives, often in a surreptitious manner. We predict this

dimension to be most predictive of magic enjoyment when they already know the secret

because this allows them to have a "shared secret" with the magician, providing a sense of

security and connection with the magician. As a result, they can also revel in sharing a "duping delight" (Ekman, 1981) with the magician. Consequently, we predict less enjoyment as the degree of secrecy increases.

On the other hand, the dimension of general social curiosity is indicative of more friendly ways of getting to know someone. This type of person may be more interested in who the magician is as a person, the magician's background or where the magic was learned. Because these factors are not contingent on the trick's secret, we predict no relationships between magic enjoyment and general social curiosity.

The dimension of deprivation sensitivity relates to solving problems or puzzles, and stems from a drive to reduce knowledge gaps, often caused by the frustration of not knowing a solution. Therefore, we expect deprivation sensitivity to strongly predict enjoyment of confidently figuring out secrets. This "aha moment" was qualitatively associated with a sense of pride and tension in a prior study using magic tricks (Danek et al., 2014). If these problem solvers never figure out the secret, they might feel very frustrated and thus diminish their enjoyment. It is, however, possible that they still enjoy never knowing secrets because they enjoy the meaningful *process* of figuring out secrets. This enjoyment would nevertheless be lower than completely figuring out the secret because they miss out on the large emotional contrast between the frustration and the positive feelings of an insightful "aha moment". Likewise, already knowing the secrets would be enjoyed least because there would be no chance for a meaningful sense of accomplishment, nor any intellectual meaning from trying to figure out the secret. Thus, the magic would be perceived as boring.

Similar to deprivation sensitivity, people who score high on the thrill-seeking curiosity dimension are predicted to find magic very boring if they already know the secrets. Thrill-seeking curiosity is characterized by risk taking, spontaneity, and unpredictability. These are all lost when secrets are known because secrets are what create the surprising impossibilities of magic. This means that thrill seekers would enjoy the surprising, unexpected moments the most when secrets are never figured out. They would find the

impossible magic moment to be to disconcerting, perhaps even risky, especially if they imagine it occurring outside of the context of a magic show in normal life. As a result, they would intensely enjoy magic when they never know the secrets and this enjoyment would diminish as the degree of secrecy decreases.
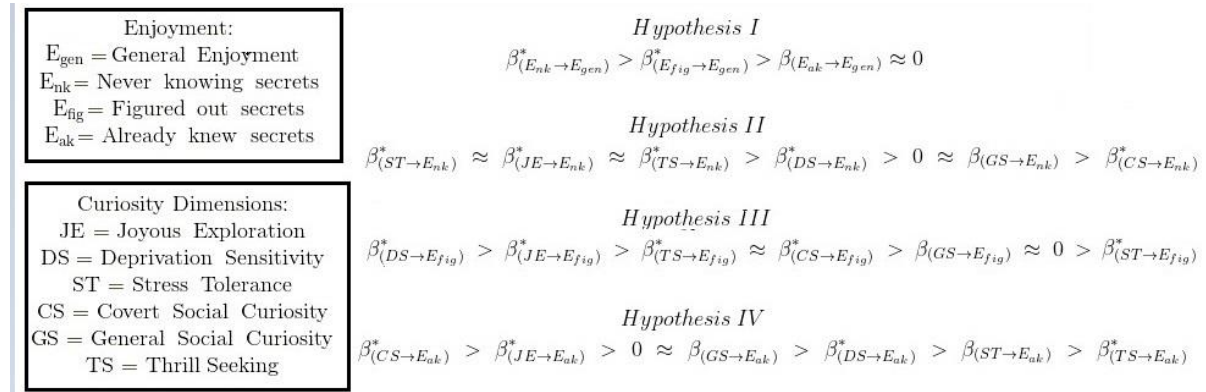

Figure 1. Hypotheses for all six curiosity dimensions and their relationships to magic enjoyment across varying degrees of secrecy in the structural question model. Beta coefficients in the structural equation model are given with asterisks indicating that the coefficient is significantly different than zero.

7.2 Methods

7.2.2 Participants and procedure

The sample was sourced from the online Prolific platform with and screened by English as a first language. The sample size was 462 participants (281 females, 175 male, 6 undisclosed) with a mean age of 32.5 (SD = 12.0). A minimum sample size of 460 was calculated according to guidelines set forth by Jackson (2003) based on the number of parameters in the structural equation model. All participants were sourced from United Kingdom and pre-screened for English as their native first language. If a participant failed the attention check or performed magic professionally, they were excluded from data analysis.

All participants were redirected from Prolific to the Qualtrics questionnaire, which consisted of a consent form, demographic information, magic enjoyment measures, and items regarding individual differences in curiosity. Procedures and measures were all approved by the University's ethics committee.

7.2.3 Measures

After collecting age and gender, participants were asked if they had experience in learning magic and if so, they had to select whether they were a "hobbyist", "hobbyist with occasional public or other performance", "part-time professional", "Full-time professional", or other. We excluded professionals since they would be more likely to have seen the magic video and known some of the tricks. The questionnaire began by asking students "How much do you enjoy watching magic tricks" on a continuous slider scale with values from 0 to 100, ranging from "I do not enjoy watching magic tricks at all" to "I enjoy watching magic tricks more than anything else". On the next page of the questionnaire, they were asked to rate their enjoyment under three hypothetical scenarios. The first scenario was "How much would you enjoy magic tricks if you never figured out the secrets to the magic?" The second was "How much would you enjoy magic tricks if you confidently figured out the secrets to the magic on your own?". We used the word "confidently" because we wanted to avoid the grey area of having an idea but not being sure. The third scenario was "How much would you enjoy magic tricks if you already knew the secrets to the magic before the performance?" The scales for these three items ranged from "I would not enjoy magic tricks at all" to "I would enjoy magic tricks more than anything else" with values from zero to one hundred. We recognize that never figuring secrets may be analogous to overall enjoyment since this is presumably the most common occurrence when watching magic. However, we did not want to assume this to be the case, especially since no data exists on the prevalence for each of the three secrecy conditions during general magic performances.

After completing all enjoyment measures, participants completed the revised five-dimensional curiosity scale (Kashdan et al., 2020) to measure individual differences in curiosity. The scale contains six factors, which consist of joyous exploration, deprivation sensitivity, stress tolerance, thrill seeking, general social curiosity, and covert social curiosity. Reliability assessed by Cronbach alpha was suitable for all factors (i.e. above 0.8; Nunnally & Bernstein, 1994).

7.2.4 Construction of Structural equation model

The full model is outlined in Figure 2. Individual differences in curiosity were inevitably chosen as the exogenous variables. Since the study is largely exploratory, all six curiosity dimensions were used to predict each of the three enjoyment measures regarding secrets. In line with our theoretical rationale that secrets play a role in our general enjoyment of magic, all three enjoyment measures regarding secrets predicted general enjoyment of magic. The curiosity dimensions were all allowed to co-vary with each other since they all generally related to the concept of curiosity and were correlated in the scale's initial development (Kashdan et al., 2018).

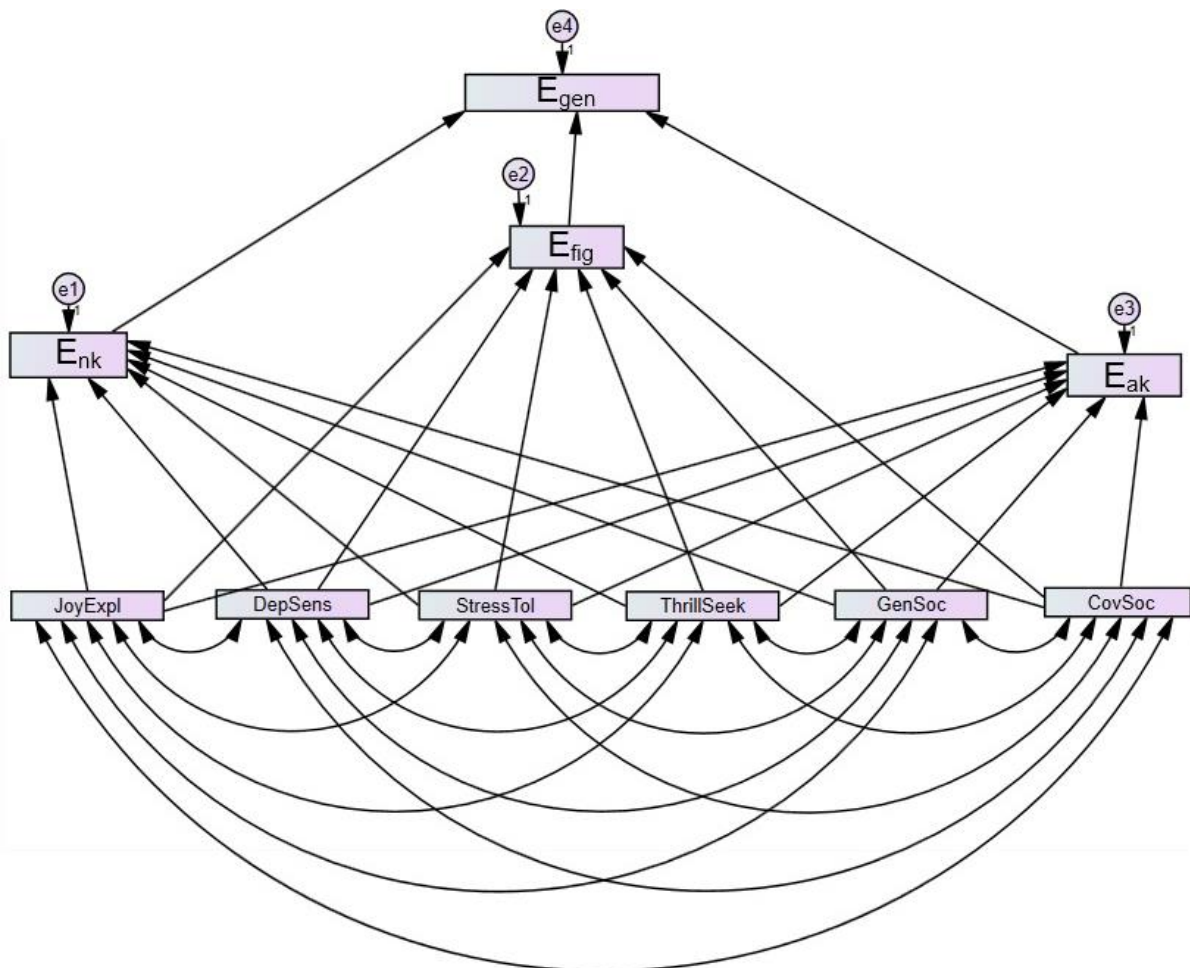*Figure 2.* Hypothetical model linking general magic enjoyment (E_{gen}) to enjoyment of magic when the secrets are never known (E_{nk}), figured out (E_{fig}), and already known before the performance (E_{ak}) as well as curiosity dimensions of Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Thrill Seeking, General Social, and Covert Social curiosity.

7.3 Results and Analyses

7.3.1 Statistical Analysis

Analysis was carried out using the SPSS AMOS 24 model-fitting program, using maximum likelihood estimation. Model fit statistics were evaluated using chi-squared test results, Tucker-Lewis Index (TLI), confirmatory fit index (CFI), root mean square error of approximation (RMSEA), and goodness of fit index (GFI). The chi-squared test was given lowest priority and only used for rough approximations during model respecification since chi-squared is very sensitive to sample size and no longer relied upon as a basis for acceptance or rejection (Schermelleh-Engel et al., 2003; Vandenberg, 2006). Individual beta weights and p-values were used to evaluate individual predictors. Results from modification indices were used to improve the model by adding the suggested model pathways, provided they had a sound theoretical rational. For example, it would not logically make sense for someone to enjoy never knowing secrets because they enjoy knowing them, which is present in enjoyment from both figuring out secrets and already knowing secrets. On the other hand, it's theoretically sound that already knowing the secret might act as a "hint" and assist someone in figuring out exactly when and where the secret was used during the live performance. This was the rational we ultimately chose because enjoyment from figuring out secrets was a significant predictor of general enjoyment in the primary model. Pathways were first removed if the corresponding beta coefficient's p-value was greater than 0.1 to ensure we did not delete borderline cases of the primary model. This process was then repeated until the model converged with pathways significant at 95% confidence levels for beta coefficients. The resulting model is shown in Figure 2 and all correlations are presented in Table 1.
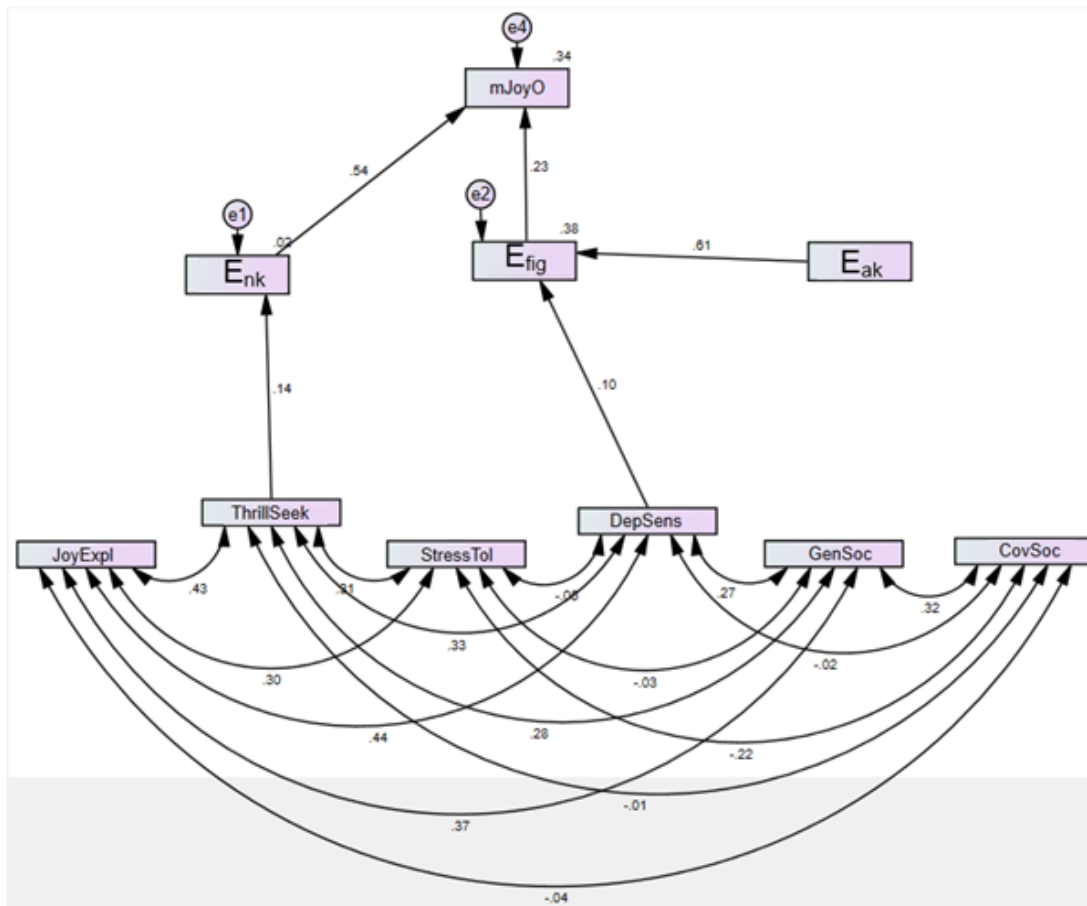
Figure 3. Final respecified model from analysis showing relationships amongst general magic enjoyment (E_{gen}), magic enjoyment when the secrets are never known (E_{nk}), enjoyment of figuring out secrets (E_{fig}), and enjoyment if secrets are already known (E_{ak}) before the performance as well as curiosity dimensions of Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Thrill Seeking, General Social, and Covert Social curiosity. Values on single headed arrows are standardized beta coefficients whereas values on double-headed curved arrows indicate correlation coefficients.

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Table 1 Correlation Matrix for all measures of magic enjoyment and all curiosity dimensions.

	E_{gen}	E_{nk}	E_{fig}	E_{ak}	Joyous Exploration	Deprivation Sensitivity	Stress Tolerance	Thrill Seeking	General Social
E_{nk}	.557**								
E_{fig}	.284**	.108*							
E_{ak}	.252**	.195**	.605**						
Joyous Exploration	.103*	0.089	0.043	-0.032					
Deprivation Sensitivity	.136**	0.055	0.079	-0.032	.445**				
Stress Tolerance	.103*	.096*	0.009	0.043	.302**	-0.053			
Thrill Seeking	.183**	.143**	0.073	-0.003	.429**	.328**	.305**		
General Social	0.007	-0.014	0.050	-0.033	.375**	.270**	-0.035	.277**	
Covert Social	-0.055	-0.091	0.078	0.026	-0.040	-0.019	-.222**	-0.005	.320**

Note. * $p < .05$ (two-tailed). ** $p < .01$ (two-tailed).

7.3.2 Model Results

A summary of model fit statistics for the primary model and final respecified model are

presented in Table 1. All model fit statistics in the final model were good (Crowson, 2021) with

TLI, CFI, and GFI all above 0.9, and an RMSEA value less than .05.

A summary of the beta coefficients for direct and indirect effects for the final respecified model

are presented in Table 2. All beta coefficients in the final model were significant at the $p < 0.01$

level.

Squared multiple correlation values indicated that the model predictors accounted for

34.5% of the variance in general magic enjoyment, which suggests that a nontrivial amount of

general magic enjoyment stems from factors unrelated to the secrets. The predictors of

enjoyment from figuring out secrets accounted for 37.8% of the variance in enjoyment from

figuring out secrets. The thrill-seeking predictor for enjoyment of never knowing secrets

accounted for 2% of the variance in enjoyment of never knowing secrets.

Table 2 *Standardized path coefficients for predictors of general magic enjoyment.*
*Significant at p < .01 level.
**Significant at p < .001 level

	Effects		
	Direct	Indirect	Total
	M	M	M
Secrecy			
Never knowing secret	.54**	none	.54
Figuring out the secret	.23**	none	.23
Already knowing the secret	none	.14**	.14
Curiosity			
Joyous Exploration	none	none	none
Thrill Seeking	none	.08*	.08
Stress Tolerance	none	none	none
Deprivation Sensitivity	none	.02*	.02
General Social	none	none	none
Covert Social	none	none	none

Table 3 *Goodness of fit indices for primary model and final respecified model.*

Fit index	χ^2 (d.f)	P	CFI	GFI	TLI	RMSEA
Primary model	245.15 (9)	<.001	.743	.918	0.00	.239
Final respecified model	43.51 (35)	.012	0.98	0.98	0.96	0.04

7.4 Discussion

We utilized structural equation modelling to understand how individual differences in curiosity predict people's enjoyment of magic across varying degrees of secrecy. As predicted, our results showed that never figuring out the secrets was the largest predictor of magic enjoyment. Confidently figuring out the secrets was also a significant predictor of general magic enjoyment. While knowing the secrets did not predict general magic enjoyment, it did however significantly predict enjoyment of figuring out secrets, independent of any curiosity individual differences. The two pathways linked to curiosity dimensions that we found were 1) thrill seeking curiosity predicts enjoyment of never knowing the secrets, and 2) deprivation sensitivity predicts enjoyment of figuring out secrets.

Enjoyment of never figuring out the secrets aligns with the widespread recommendation from the magic community to not reveal secrets. This enjoyment was significantly predicted by thrill seeking curiosity. In Kashdan's original paper, thrill seeking was characterized as those who enjoy risk-taking for the sake of pleasure and strongly correlated with a willingness to tolerate volatility, uncertainty, and ambiguity (Kashdan et al., 2018). This aligns with prior research on magic eliciting surprise (Parris et al., 2009) and surprise being what audiences enjoy most (Grassi & Bartels, 2021; Jay, 2016). This may suggest that thrill seekers view this unexpected surprise as a highly unpredictable thrill, and hence enjoy magic a great deal. It may

also be reflective of thrill seekers being drawn to the dramatic reactions seen on TV popularized by magicians like David Blaine or Dynamo. That said, this subgroup appears to be a rather small subset of the general population as it only explained about two percent of enjoyment from never knowing secrets.

On the other hand, we also found evidence for a subset of people who genuinely enjoy figuring out the secrets of magic. This was firstly observed in the revealing relationship between enjoyment of figuring out secrets and already knowing secrets. Prior to data collection, this relationship had sound theoretical rationales for the correlation to go in either direction. A negative correlation would suggest that already knowing the secret will spoil the fun of trying to figure it out, similar to how a plot twist may lack excitement if it was given at the start of a story. Our data, however, shows a positive correlation between enjoyment of figuring out secrets and already knowing secrets. For this rationale, the secret knowledge may act as an appreciated "hint'" that helps the individual figure out when and where it was used during the live performance. Moreover, this aspect was independent of curiosity dimensions as indicated by the near zero correlations between enjoyment of already knowing the secret and all curiosity dimensions. While it's possible that a third unmeasured factor is responsible, the rationale of an "appreciated hint" aligns better with prior research on people feeling pride and a release of tension when figuring out secrets (Danek et al., 2014). This aspect of already knowing secrets assisting the enjoyment of figuring out secrets may also be relevant to Silvia's (2020) finding that more disagreeable people hate magic more. If disagreeable, uncooperative people hate magic, then perhaps agreeable people who go along with the magic would view the prior secret knowledge as a team effort in figuring out the puzzle of the magic. To find out if this is the case, future studies could examine this relationship between enjoyment of magic when given secrets and agreeableness or other cooperative individual difference measures.

The second largest predictor of enjoyment from figuring out secrets was deprivation sensitivity, which has a strong theoretical rationale. These are the "problem solvers" of the world, who are driven by frustration and a need to find answers to the unknown. As predicted, people scoring high in this dimension enjoyed confidently figuring out the secrets, which suggests they view magic as a puzzle to be solved. The lack of a significant pathway to enjoyment of never knowing secrets also suggests that the pride or "aha moment" of figuring out the secret are more substantive factors for these individuals than any enjoyment from the *process* of figuring out solutions, since the latter would also be present if they never figured out the secret.

Despite these factors playing a legitimate role in people's enjoyment of magic, it is important to point out that secrets accounted for roughly a third of the variance in people's general enjoyment of magic. This is to be expected as many other performance factors are often involved in a magic show, such as the showmanship, comedy, drama, music, and so on. Therefore, future lines of work could examine the impact and interaction of this "theatrical dressing" on the magic enjoyment. For example, would combining the surprise of magic with a well-timed joke enhance its humour?

Our study is not without limitations. While theoretical rationales for causation seem strong, we did not directly test causation. After all, spectators only predicted their enjoyment and are unlikely to have actual experience with the bizarre scenario of being told all the secret methods before watching a magic performance. The reality could be very different than what they imagine. That said, results nevertheless provide useful guidelines for future experiments. For example, participants could all watch the same magic routine with one condition given the secrets used to see how it affected their enjoyment. Another study could take a sample of people who score high on deprivation sensitivity and compare enjoyment between those who figured out the secret versus those who did not.

The structural equation model provided more nuanced results for furthering our understanding of magic enjoyment. Individual differences in curiosity across varying degrees of secrecy were observed, with thrill seekers enjoying the mysterious nature of never figuring out secrets whereas the problem solvers scoring high in deprivation sensitivity enjoyed figuring out the secrets. In addition, we observed that already knowing secrets predicted enjoyment of figuring out the secret, which we hypothesized to be akin to giving a spectator a helpful "hint" in figuring out exactly when and where it will be applied during the live performance. Both figuring out secrets and never knowing secrets accounted for a significant portion of people's overall magic enjoyment, while also leaving plenty of room in the unexplained variance that is likely due to other presentational factors that are unrelated to secrets.

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Chapter 8: The magic of wow: Investigating wonder in magic tricks through the lens of awe

Abstract:

Wonder has fueled the sciences and sparked imagination for ages. However, the field of psychology rarely discusses wonder, and in the few instances it does, wonder is typically grouped alongside the emotion of awe. Since magicians aim to create wonder, magic tricks would be a useful tool to study the experience of wonder. Drawing on prior theoretical accounts of the magic experience, we postulate wonder to be a dynamic emotional experience that oscillates amongst emotions of awe, curiosity, confusion, and humour, which is catalysed by a sudden moment of surprise. In magic tricks, we hypothesize awe to arise when a high rate of impossible moments vastly exceeds the spectator's rate of generating explanations for the impossible moment. One way that magicians influence these two rates is through performance elements and the frequency of magic moments. Therefore, we set out to determine whether these aspects are indeed relevant to the emotion of awe by conducting a set of experiments. In experiment one, we investigated the extreme of full theatrics with a very high rate of magic moments and compared it to a contextually similar juggling condition with no impossible moments. For the second experiment, the opposite extreme was investigated by comparing a minimal magic performance (devoid of performance elements and a slow rate of magic moments) to a matched condition of someone "juggling" with cards. Results indicated that magic videos were consistently rated higher in enjoyment than the comparison video, but surprisingly neither experiment showed any differences in awe between the two performances. Implications of studying the construct of wonder are discussed and suggestions made for future research.[12]

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[12] This chapter has not yet been submitted to an academic journal for publication.

8.1 Introduction

Wonder has fueled both the sciences and humanity's general thirst for knowledge throughout the millennia. If Galileo had not wondered about the stars or the speed of falling objects, he never would have contributed his theories of astronomy, gravity, and free fall to the world. Darwin was also moved by a sense of wonder, stating how his research "…creates a feeling of wonder that so much beauty should be apparently created for such little purpose" (Darwin, 2009, p. 22). This sense of wonder has been a common theme in the lives of the greatest scientists throughout history (Bersanelli & Gargantini, 2009). The emotional processes of wonder cause us to not only ponder the bigger questions of life but also to act in ways that bring us closer to answering these questions.

Thus far, scientific endeavours into the emotion of wonder have been largely restricted to research on awe. In general, the psychological sciences frame wonder as a concept alongside the emotion of awe (e.g. Anderson et al., 2019; Keltner & Haidt, 2003; Silvia et al., 2020), yet awe is not entirely congruent with our everyday usage of wonder (e.g. "I wonder how he did that", "I wonder what happens if I try this", etc.). In many regards, wonder seems more reflective of curiosity than grand feelings of awe. For example, Keltner and Haidt (2003) suggest that a need for accommodation is central to the experience of awe, and that this need may or may not be met, which mirrors both the magic experience and the onset of curiosity. Bagienski and Kuhn (2019) posit that wonder might be a combination of emotions, lying at the intersection of curiosity and awe.   This view is supported by recent research on emotions that used visual stimuli, revealing that human emotions exist across smooth gradients from one emotion to the next, with awe and curiosity (i.e. interest) occupying overlapping areas in the "emotions map" they developed (Cowen & Keltner, 2017). A replication of this work utilizing vocal tones (rather than visual stimuli) also reveals

that curiosity and awe occupy neighbouring spaces, with adjacent emotions of elation, "positive surprise" and realization (Cowen et al., 2019). Empirically, this relationship was also observed in a study that found awe-prone people to be more curious (Anderson et al., 2019).

Wonder is also central to the performance art of magic, perhaps more so than any other artform or activity. The magician intentionally aims to create and share impossibilities that make people wonder. Magician Doug Henning put it succinctly, stating that "the art of the magician is to create wonder. If we live with a sense of wonder, our lives become filled with joy". Acclaimed magician Eugene Burger also writes how performing magic brings people to a world "in which enchantment *is*, to a world in which wonder and awe are necessary ingredients of a happy and healthy life" (Burger & Neale, 1995). Not only do these anecdotes highlight the wellbeing-value of wonder, but they also suggest that skilled magicians elicit a strong sense of wonder. Thus, the performance art of magic is ideal for gaining a rich understanding of wonder.

In the prior chapters, we explored how curiosity relates to magic enjoyment, yet curiosity only partially describes wonder. Magicians often distinguish between magic and puzzles, stating that "magic" or wonder is something much greater than the curiosity evoked by an intellectual puzzle (Burger & Neale, 1995; Sankey, 2003, pp. 174–176). Thus, in this chapter we 1) explore theories of how curiosity interacts with awe and other emotions, resulting in an experience of wonder, and 2) conduct a series of experiments testing how magic tricks can elicit awe.

As discussed in Chapter 5, Leddington's (2016) theory suggests that the core experience of magic results in an intellectual conflict between what we directly perceive and what we know to be real. To further elaborate, Leddington describes how magic can elicit both positive and negative emotions (Leddington, 2017), and creates the aesthetic paradox of how people can enjoy being fooled. Drawing upon appraisal theory of interest (Silvia, 2009, p. 49), he further suggests that the paradox is resolved by magic encompassing both

aversive and attractive aspects, which results in an oscillation between emotions of interest and confusion (Leddington, 2019). He terms this theory as the Bivalent Oscillatory Model (BOM).

If the nature of magic involves an oscillation of emotions and there exists smooth gradients flowing from one emotion to another, then the BOM theory firstly implies that the magic experience is a *dynamic* emotional process. Furthermore, the gradients between neighbouring emotions imply that the oscillations may not necessarily be bivalent but rather can be swayed toward a range of neighbouring emotions. From observing the emotional gradients (see maps from Cowen et al., 2019; Cowen & Keltner, 2017), we see precisely what one may expect from magic: confusion adjacent to interest, thus allowing an oscillation between the two, and neighbouring emotions of awe, positive surprise, excitement, entrancement, and aesthetic appreciation. While the vocal emotions map also shows realization as a neighbouring emotion, it is important to remember that "realization" is precisely what magicians prevent. By removing this realization gradient, the tension between conflicting emotions may be amplified since both curiosity and confusion are experienced yet there's no longer a smooth pathway between the two, thus causing the oscillatory process.

While this process *can* be dynamic, it is unclear what exactly would sway the emotional experience in the direction of awe, and perhaps create a dynamic experience of wonder.   As Leddington (2019) highlights, the "theatrical dressing" of the magic performance, such as the safe environment, is surely one factor. But staying closer to the heart of magic, we propose that wonder can be modeled as a dynamic waveform. Akin to a vibrating guitar string, the oscillation between confusion and interest can be thought of as a wave with an amplitude and frequency, catalysed by the surprise from a magic trick's climax. The amplitude of the wave would reflect the amplitude of the oscillation between emotions and correlate with the perceived impossibility of a magic trick. This would be related to how difficult it is to conceive a possible solution, an individual's confidence in their guess, the magnitude of an expectation violation, and so on. The frequency of the wave would reflect

the frequency of the oscillation (i.e., the number of times per second that an individual's emotional state goes from interest to confusion and back). At the onset of the magical climax, amplitude would be greatest, which then diminishes as time goes on, like how a vibrating guitar string returns to its initial position after a single pluck. We believe that maintaining the amplitude (i.e. impossibility) while increasing the frequency of this oscillation could result in swaying the experience more toward awe and wonder, provided it is done so in a safe, nonthreatening context where the individual knows it's a trick.

In practice, maintaining this balance is much more challenging to achieve but one potential method for increasing the frequency of this oscillation is by comparing the rate at which impossible moments occur to the rate at which a spectator generates solutions for explaining the magic trick. Whether magic elicits wonder can then be defined as:

$$Wonder = \frac{R'_{imp}}{R'_{sol}}$$

where R'_{imp} is the rate per unit time at which impossible moments occur, and R'_{sol} is the rate per unit time at which an individual spectator generates solutions for those impossible moments that they find satisfactory. Solutions that the spectator recognizes as illogical would start the oscillation between curiosity and confusion whereas satisfactory, logical ones would completely stop the oscillation and elicit no wonder. If the number of impossible moments occurs at a much faster rate than the spectator can imagine solutions, then $R'_{imp} \gg R'_{sol}$ and an intense, prolonged experience of wonder is created. It is worth noting that wonder can also occur in performances with a single magic moment, provided that zero satisfactory solutions are generated (i.e. as R'_{sol} approaches zero, the amount of wonder approaches infinity). The vast number of impossible moments (compared to satisfactory solutions) within the same period of time may also sway the oscillation toward awe since vastness is a common theme in research on awe (Keltner & Haidt, 2003; Yaden et al., 2018).

One way that magicians often achieve this is by incorporating a story into their magic, which slows down R'_{sol} by forcing the spectator to allocate attentional resources to the story, rather than generating potential solutions to the trick. Alternatively, a skilled magician could also ramp up the total number of magical moments within a given period of time. An excellent example that combines both methods is a performance by magician Eric Chien (America's Got Talent, 2019; Chien, 2018) where on average, an impossible moment occurs every ten seconds. Furthermore, the performance contains visual story elements, and each moment scores very high on impossibility, fooling even the most experienced magicians (*Penn and Teller: Fool Us*, 2021).

Another way magicians can influence the solution generation rate, R'_{sol}, is through comedy. Leddington has argued that magic tricks are a special case of stand-up comedy, as both involve expectation violation within a safe entertainment context. In line with the broadening aspects of positive emotions (Fredrickson, 2004), humour is also likely to shut down attentional resources, compared to the narrowing, detail oriented alertness that negative emotions provide (Kashdan & Biswas-Diener, 2014). As a result, the spectator would be less capable of problem solving and figuring out the secret, thus decreasing their idea generation rate for explaining the hidden secrets of magic.

In the present study we set out to test some of these ideas across a series of experiments. The first study utilized Eric Chien's performance and aimed to first and foremost, evaluate whether magic tricks can elicit awe. Furthermore, our experiment aimed to determine which aspects of awe are most common in a highly effective magic performance by a skilled professional and how they relate to enjoyment of magic. We recognize that the scientific literature on awe is still growing, so we took an exploratory approach by measuring all dimensions of the most comprehensive state measure of awe (Yaden et al., 2018). These dimensions encompass altered time perception, self-diminishment, connectedness, perceived vastness, physical sensations, and need for accommodation.

In the second experiment, we then stress tested the opposite extreme to determine whether these aspects of awe would replicate in magic performances where the rate of impossible moments, story elements, music, and other theatrical aspects were minimized. In doing so, we aimed to zone in on the aspects of awe that are most robust to magic tricks in general.

To control for effects of lingering confounds, we also utilized a comparable control group in both experiments. We chose displays of manual dexterity as an active control since audiences are typically familiar with "sleight of hand" as a common method for achieving magic tricks. Furthermore, this approach allowed us to create an active control condition in the second experiment where the same exact objects were used in both groups.

We anticipate that the most robust aspect to be the "need for accommodation" dimension of awe whereas other aspects may be present in the full theatrical performance but not the basic minimalist performance.

8.2 Experiment 1

8.2.1 Methodology

Participants and Procedure

Participants in the final sample were 207 survey respondents (69 male, 134 female, 4 undisclosed) recruited via Prolific's online software. The average age was 33.5 (SD = 13.1). Participants were paid a rate of £7.52 per hour to compensate for their time. Goldsmiths Psychology Department provided ethical approval for the experiments.

Participants filled out a Qualtrics survey where they completed demographic information, and were randomly assigned to either the magic or control condition. Next, they were instructed to watch the video performance as if they were experiencing it live and immediately afterwards completed the Awe-S scale.

Videos

Since the aim of this first experiment was to determine whether a magic performance with full theatrics will induce feelings of Awe, we chose the America's got talent version of Eric Chien's magic performance. This included all of the "theatrical dressing" including music, visual storytelling, social dynamics from audience applause, and visible reactions of spectators (i.e. judges and host). Furthermore, this performance had the highest rate of impossible moments out of all the videos we considered.

For our active control condition, we wanted to be sure that the theatrical context was as similar as possible to the magic video. We chose juggling since both juggling and magic are often based on manual dexterity, with juggling putting this dexterity on display whereas magic deliberately hides it. Since Eric Chien's performance included many novel magic effects, we chose bounce juggling which would also be more novel than a standard juggling performance. Like the magic video, the juggling one contained music, audience applause, and visible spectator reactions. The rate of "juggling tricks" was also estimated to be approximately equal to the rate of impossible moments in the magic video: the juggling video contained .09 tricks per second while the magic video contained .11 impossible moments per second (see *https://tinyurl.com/awevids* for all videos).

Measures

To measure awe, we used the awe experience scale (Awe-S; Yaden et al., 2018). The scale has six factors: altered perception, self-diminishment, connectedness, perceived vastness, physical sensations, and need for accommodation. The scale asks participants to rate items using a 7-point scale ranging from "Strongly Disagree" to "Strongly Agree" and was based on prior research investigations on the state experience of Awe. Reliability assessed by Cronbach alpha was good (i.e. above 0.8; Nunnally & Bernstein, 1994) for all domains of awe.

Participants also rated their enjoyment of the performance in the video clip. This item asked participants "How much did you enjoy watching this performance?" on a continuous slider scale with values from zero to one hundred, where zero was labelled "I did not enjoy it at all" and 100 was labelled "I enjoyed it more than anything else".

8.2.2 Results and Analysis

To analyse which aspects of awe were most prominent in magic compared to the control, a 6 x 2 mixed factorial ANOVA was used with dimensions of awe as the within subject factor and condition as the between groups factor. Participants were excluded from the analysis if they indicated that they saw the performance before, failed an attention check, had a professional level of experience doing magic, or if the time spent on the survey page was less than half the duration of the video clip. All variables were normally distributed as assessed by values of skew and kurtosis as per Curran et al.(1996). Means for all measures are presented in Table 1.

All assumptions were satisfied except for sphericity, so the Huynh-Feldt correction was used. Results of the mixed factorial ANOVA indicated a significant main effect of awe, $F(3.42, 702.01) = 51.11$, p < .0001. Post hoc tests revealed significant differences as indicated in Table 1 below.

Table 1 *Bonferroni adjusted pairwise comparisons of Awe subscales.*

* The mean difference is significant at the .05 level.

Awe- Subscale		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Altered time perception	Self-diminishment	0.83*	0.09	0.00	0.57	1.09
	Connectedness	0.66*	0.09	0.00	0.39	0.93
	Vastness	0.22	0.11	0.70	-0.11	0.55
	Physiological Sensations	0.01	0.13	1.00	-0.37	0.39
	Need for Accommodation	-0.59*	0.12	0.00	-0.94	-0.23
Self-diminishment	Connectedness	-0.17	0.07	0.21	-0.38	0.03
	Vastness	-.61*	0.10	0.00	-0.90	-0.32
	Physiological Sensations	-.82*	0.12	0.00	-1.17	-0.47
	Need for Accommodation	-1.42*	0.12	0.00	-1.76	-1.07
Connectedness	Vastness	-.44*	0.07	0.00	-0.66	-0.22
	Physiological Sensations	-.65*	0.10	0.00	-0.95	-0.34
	Need for Accommodation	-1.24*	0.11	0.00	-1.56	-0.92
Vastness	Physiological Sensations	-0.21	0.07	0.08	-0.43	0.01
	Need for Accommodation	-.81*	0.10	0.00	-1.10	-0.51
Physiological sensations	Need for Accommodation	-.60*	0.09	0.00	-0.87	-0.32

There was no significant interaction, $F(3.42, 702.01) = 0.38$, p = .79 nor a main effect of video condition $F(1, 205) = 0.45$, p = .51.

On the other hand, enjoyment of the performances did differ significantly between the magic and the juggling video. An independent samples t-test revealed that participants enjoyment of the magic (M = 75.2, SD = 26.9) was significantly more than the enjoyment of the juggling video (M = 48.4, SD = 29.6), $t(205) = 6.81$, p < .001, cohen's $d = 0.95$.

Regression analyses were also conducted to see if awe subdomains predicted enjoyment of magic. For the magic group, it did not meet the assumption of homoscedasticity so the macro developed by Hayes & Cai (2007) was used for adjusted standard errors. No multicollinearity was present according to tolerance levels. The regression was not a significant predictor of magic enjoyment, model $R^2 = .05$, $F(6, 95) = 0.86$, $p = .53$). None of the subdomains of awe were significant predictors in the model ($p > 0.2$ for all subdomains).

The regression for the juggling condition also used subdomains of awe as predictors of juggling enjoyment. Data met the assumption of homoscedasticity and contained no multicollinearity according to tolerance levels. The regression was not a significant predictor of juggling enjoyment, model $R^2 = .05$, $F(6, 98) = 0.91$, $p = .49$). None of the subdomains of awe were significant predictors in the model ($p > 0.2$ for all subdomains).

Table 1 *Means and standard deviations for performance enjoyment ratings and subdomains of awe for N= 207 participants (standard deviation in parentheses).*

	Magic	Juggling
Enjoyment	75.2 (26.9)	48.4 (29.6)
Time Perception	3.0 (1.5)	3.1 (1.4)
Self-Diminishment	2.1 (1.2)	2.3 (1.3)
Connectedness	2.4 (1.2)	2.4 (1.3)
Vastness	2.8 (1.5)	2.8 (1.6)

Physiology	3.0 (1.6)	3.1 (1.7)
Need for Accommodation	3.6 (1.5)	3.7 (1.6)

8.3 Experiment 2

8.3.1 Methodology

Participants and Procedure

Participants in the final sample were 210 survey respondents (87 male, 121 female, 2 undisclosed) recruited via Prolific's online software. The average age was 31.9 (SD = 11.3). Participants were paid a rate of £7.52 per hour to compensate for their time. Goldsmiths Psychology Department provided ethical approval for the experiments.

Participants were redirected to a Qualtrics survey where they completed demographic information, and randomly assigned to either the magic or control condition. Next, they were instructed to watch the video performance as if they were experiencing it live and immediately afterwards completed the Awe-S scale.

Videos

For the magic videos, we wanted to ensure that the tricks themselves still contained the core cognitive conflict of magic, while at the same time lacking as many confounding theatrical and performance aspects as possible. To do so, we utilized the validated magic tricks developed by Ozono et al. (2021) and selected three videos among the top six videos that scored highest in the Ozono's mean ratings of surprise, curiosity, and interest. Since the prior experiment utilized a card trick, we also only chose card tricks. The top three videos for interest and curiosity were the same videos whereas two of these were in the top two for surprise. The third video was fourth in terms of surprise ratings, so we chose to use these three videos. The three videos were counterbalanced and randomly presented to participants assigned to the magic condition. The videos themselves were filmed with a

plain back background, were silent, and were recorded in such a way that that neither the magician's face nor the spectator's was ever visible to bias reactions.

For the control, we utilized a sequence of three "cardistry" videos (Nguyen, n.d.), which involves a range of sophisticated ways to cut, shuffle and display cards using one's physical dexterity of the hands. We chose cardistry so that the same object was used in both the magic and cardistry condition. The three videos were counterbalanced and randomly presented to participants assigned to the cardistry condition. Like the magic videos, all cardistry videos contained a plain back background, were silent, and were recorded in such a way that the performer's face was never visible (see https://tinyurl.com/awevids for all videos).

Measures

The same exact awe (Yaden et al., 2018) and enjoyment measures from the first experiment were used in this experiment. Reliability assessed by Cronbach alpha was good (i.e. above 0.8; Nunnally & Bernstein, 1994) for all domains of awe.

8.3.2 Results and Analysis

To analyse which aspects of awe were most prominent in magic compared to the control, a 6 x 2 mixed factorial ANOVA was used with dimensions of awe as the within subject factor and condition as the between groups factor. Participants were excluded from the analysis if they indicated that they saw the performance before, failed an attention check, had a professional level of experience doing magic, or if the time spent on the survey page was less than half the duration of the video clip. All variables were normally distributed as assessed by values of skew and kurtosis as per Curran et al.(1996). Means for all measures are presented in Table 2.

All assumption were satisfied except for sphericity, so the Huynh-Feldt correction was used. Results of the mixed factorial ANOVA indicated a significant main effect of awe, $F(3.76, 780.99) = 60.46$, p < .0001. Post hoc tests revealed significant differences as indicated in Table 1 below.

Table 3 *Bonferroni adjusted pairwise comparisons of Awe subscales in the minimal performances.*

Awe- Subscale		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Altered time perception	Self-diminishment	.97*	0.09	0.00	0.72	1.23
	Connectedness	.78*	0.09	0.00	0.51	1.05
	Vastness	.45*	0.10	0.00	0.14	0.75
	Physiological Sensations	0.30	0.12	0.18	-0.05	0.66
	Need for Accommodation	-.46*	0.11	0.00	-0.80	-0.12
Self-diminishment	Connectedness	-0.19	0.07	0.14	-0.41	0.03
	Vastness	-.53*	0.08	0.00	-0.77	-0.28
	Physiological Sensations	-.67*	0.11	0.00	-0.98	-0.35
	Need for Accommodation	-1.43*	0.11	0.00	-1.75	-1.12
Connectedness	Vastness	-.33*	0.06	0.00	-0.50	-0.16
	Physiological Sensations	-.48*	0.09	0.00	-0.73	-0.22
	Need for Accommodation	-1.24*	0.11	0.00	-1.55	-0.93
Vastness	Physiological Sensations	-0.14	0.07	0.60	-0.35	0.06
	Need for Accommodation	-.91*	0.10	0.00	-1.19	-0.62
Physiological sensations	Need for Accommodation	-.76*	0.10	0.00	-1.07	-0.46

There was no significant interaction $F(3.76, 780.99) = 2.12$, p = .08 nor a main effect of video condition $F(1, 208) = 0.17$, p = .68.

As in the first experiment, enjoyment of the performances differed significantly. An independent samples t-test revealed that participants enjoyment of the magic (M = 66.4, SD = 25.1) was significantly more than enjoyment of the cardistry video (M = 46.0, SD = 26.4), $t(208) = 5.73$, p < .001, cohen's $d = 0.79$.

Regression analyses were also conducted to see if awe subdomains predicted enjoyment. For the magic group, the assumption of homoscedasticity was met and contained no multicollinearity according to tolerance levels. The regression was not a significant predictor of magic enjoyment, model $R^2 = .01$, $F(6, 96) = 0.09$, $p = 1.00$. None of the subdomains of awe were significant predictors in the model ($p > 0.5$ for all subdomains).

The regression for the juggling condition also used subdomains of awe as predictors of juggling enjoyment. Data met the assumption of homoscedasticity and contained no multicollinearity according to tolerance levels. The regression was not a significant predictor of cardistry enjoyment, model $R^2 = .05$, $F(6, 100) = 0.83$, $p = .55$). None of the subdomains of awe were significant predictors in the model ($p > 0.1$ for all subdomains).

Table 2 *Means and standard deviations for enjoyment ratings and subdomains of awe for minimal performances, devoid of theatrics (standard deviation in parentheses).*

	Magic	Cardistry
Enjoyment	66.4 (25.1)	46.0 (26.4)
Time Perception	3.0 (1.3)	3.2 (1.6)
Self-Diminishment	2.1 (1.2)	2.2 (1.3)
Connectedness	2.3 (1.3)	2.3 (1.4)
Vastness	2.7 (1.3)	2.6 (1.5)

Physiology	2.9 (1.5)	2.7 (1.6)
Need for Accommodation	3.7 (1.5)	3.4 (1.6)

8.4 Combined post-hoc analysis

To determine whether the full theatrical performances elicited a different amount of awe than the stripped down, minimal performances, we decided to conduct a three-way ANOVA as an analysis after observing the data. The homogeneity of variance assumption was satisfied for all levels of Awe using Levene's test except for time perception, $F(3, 413) = 2.81$, p =.04. Results indicated no between-groups effect of experiment, $F(1, 413) = 0.97$, p = 0.33 nor a between-groups effect for type of performance art, $F(1, 413) = 0.03$, p = 0.90. There was no interaction effect between Awe and type of performance art, $F(5, 2065) = 1.39$, p = 0.22, nor an interaction between awe and theatrical condition (i.e. full vs minimal performance), $F(5, 2065) = 1.05$, p = 0.36, nor an interaction between awe, type of performance and theatrical condition, $F(5, 2065) = 1.01$, p = 0.41.

8.5 Discussion

The set of experiments aimed to highlight the flavours of awe that are unique to the performance art of magic. Surprisingly, we observed no significant differences for any of the dimensions of Awe between magic and our juggling control groups. This was also true for the factor of need for accommodation, which resembles the cognitive conflict that magic is thought to elicit and contains scale items such as "I felt challenged to mentally process what I was experiencing". The lack of an effect persisted regardless of whether it was a full theatrical experience or a minimalist performance, devoid of many potential confounds. Enjoyment, however, was consistently higher for the magic condition compared to the juggling groups.

Rather than a total absence of awe, the mean scores on the awe subscales are unclear on the amount of awe elicited in both performances. A prior study using the Awe-S scale observed mean values 1.87 (SD = 1.09) for a neutral video and values of 4.90 (SD = 1.20) for a video eliciting positive awe, while our videos elicited means ranging from 2.1 to 3.7 for the Awe-S subscales. These findings may imply that the emotional experience of magic is centred on certain emotions like surprise or curiosity, and become spread more thinly across other emotions, causing the amount of time spent in a state of awe to be very short lived. Thus, the overall evaluation for these moments of awe would be weak. It would be interesting to see if this pattern changes based on the framing of the performance, such as in mentalism performances (i.e. mind-reading, clairvoyance, etc.) where equally impossible things occur with the exception of the audience not knowing whether the demonstration was merely a trick. Without the contextual framing of magic being a "trick", the mentalism experience might be perceived as a natural phenomenon, which aligns with the prevalence of prior awe research being studied in nature (Bai et al., 2017; Silvia et al., 2015). Seeing the performance live may also play an important factor since videos often lack the social contagion present in a live audience.

Magic tapping into greater breadth of emotions may also be related to overall enjoyment of the performances. Unlike awe, the magic performances were rated as more enjoyable than the dextrous juggling performances. Since both non-magic performances were predominantly displays of mechanical skill, there was naturally less tension from unknown secrets, and thus may contain fewer negative emotions like confusion, resulting in a narrower range of emotions being provoked. To test this, future studies could replicate our experimental design while asking participants to rate a comprehensive set of emotions. This would allow us to analyse whether a broader number of emotions predict enjoyment in magic compared to the non-magic performance.

To examine the composition of this emotional fingerprint of magic, future studies could measure a comprehensive breadth of emotions to zone in on the ones most relevant

to magic. Theoretical frameworks, including the distancing embracing model (Menninghaus et al., 2017), a framework of magic and comedy (Leddington, 2020) and Leddington's (2019, 2021) application of Silvia's (2009) appraisal theory of interest and confusion, would all suggest that this emotional fingerprint to comprise a breadth of positive and negative emotions. It may be that surprise from the magical moment(s) catalyses a dynamic emotional experience that rapidly shifts from one emotion to the next or, perhaps, provokes multiple emotions simultaneously. These concepts mirror the literature on dialectical emotions (Hui et al., 2009; Miyamoto & Ryff, 2011; Shiota et al., 2010; Spencer-Rodgers et al., 2010), which may be another useful perspective on understanding the emotional enjoyment of magic.

Our study is limited in that it lacked an inactive control group, which would have helped ascertain whether both performances elicited a significant amount of awe. Another limitation is the contextual format of it being an online study, meaning we had no observations of whether they adhered to the protocol of watching the performances. Furthermore, this context of watching on a screen and being paid to watch performances is very different than a live performance, where in the real-world audience members self-select themselves by purchasing tickets and are physically present with the audience. Although minor, our study is also limited in generalising to other cultures as our Prolific sample was entirely sourced from a United Kingdom population. Lastly, despite incorporating a highly skilled professional, the study is limited in that we are unclear whether results generalize to other types of magic tricks until further we have further replication in studies that explore the emotional experience of magic tricks.

We discovered that the magic performances were more enjoyable than our comparison performances, which contained impressive displays of dexterity and mechanical skill. However, contrary to our predictions, theatrical magic did not elicit a greater amount of awe in any of its domains, suggesting that wonder could be an entirely separate construct to be studied further by psychology, rather than listing it alongside moments of awe.

Furthermore, since awe did not predict enjoyment of magic, its unlikely to be a confound in studies on magic enjoyment. I postulated wonder to be a dynamic emotional process and for magic tricks, this could be related to the rate of magic moments in a performance and the rate at which an individual generates explanations for those magic moments. This richer emotional experience of magic may help explain why our participants enjoyed the magic performances more, but until more comprehensive studies are carried out and replicated, this aspect of magic enjoyment remains a mysterious wonder.

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Conclusions

In this thesis, we have explored the social and emotional impact of both watching and learning to perform magic tricks as it relates to psychological wellbeing. Part I of this thesis thoroughly explored the extent of extant research, creating a novel hierarchy that not only helps organize prior and future research but was also used to discuss how magic falls into current psychology theories, thus setting a foundation for remaining thesis experiments. More specifically, I observed a common occurrence of participants learning to perform magic, with the strongest preliminary evidence pointing toward social benefits and improved self-esteem. For studies on watching magic, we observed curiosity and it being used as a distraction therapy. I discuss how performing magic may lead to positive social relationships, reinforced by the social reactions to a performance and how curiosity may be driving engagement in learning to perform magic. Moreover, the review discussed links between watching magic and the latest curiosity research, suggesting that individual differences might play a role. Lastly, this comprehensive foundation discussed a speculative theory on the nature of wonder, suggesting that magic might elicit awe.

A common thread that persisted throughout the thesis centred around doing what *seems* to be impossible. Part II of the thesis demonstrated not only the practical limitations of learning to perform magic interventions but also revealed the positive impact of learning to do something that seems impossible. Results from the undergraduate study in Chapter 3 support the value in using magic-based workshops for enhancing self-esteem and social aspects like closeness and community. These theoretical rationales were based on theoretical models of self-esteem where the individual not only exceeds their own expectations of what's seemingly "impossible" for them to achieve but also discuss the importance of social validation in accomplishing this impossible feat. However, to remove potential confounds and further understand these processes I needed to investigate the sole

component of learning and performing a simple magic trick. This was done by arguing in Chapter 4 that imaginal mastery experiences played an important role and I confirmed that participants indeed underestimated their ability to perform the trick, thus lending further evidence to the notion of participants exceeded their expectation of what's seemingly "impossible" for them to accomplish. Furthemore, in Chapter 4 I observed that the socioemotional reactions to the tricks played an important role in socially validating the success and thus, the experience of watching magic (i.e. something that seems impossible) was further investigated.

This experience of watching magic was investigated in Part III of the thesis, with a particular focus on enjoyment since the experience of magic *is* a form of entertainment. In Chapter 5, impossibility was found to be highly correlated with magic enjoyment, consistent with the artform's emphasis on making the impossible seem possible. A range of individual differences were then studied in Chapters 6 and 7 to determine how different types of people may like (or dislike) experiencing a seemingly impossible magic trick. By focusing on individual differences in curiosity across varying degrees of secrecy, we found that problem solvers enjoyed magic through the mechanism of confidently figuring out its secrets. On the contrary, thrill seekers enjoyed never knowing the secrets, which was most predictive of magic enjoyment. These individual differences only explained a small, yet statistically significant, amount of the total variance in magic enjoyment. To further elucidate the emotional aspects of magic, I concluded with a theory on experiencing wonder in magic and investigated whether magic tricks elicit more are than comparable performing arts. While magic tricks were enjoyed more, surprisingly there were no significant differences for any aspect of awe, suggesting that wonder could be a separate psychological construct that spans an array of emotions. Alternatively, awe from *live performing arts* may not be captured in psychology's current understanding of awe, especially since there are no theoretical frameworks that focus on aesthetic enjoyment of live performance arts.

Future research would be helpful in further clarifying the specific mechanisms on how self-efficacy and self-esteem result from mastery experiences of learning to perform magic tricks. Specifically, it is worth further investigating the dual nature of performing a magic trick since this the performance element contains conflicting information between knowing that the trick is a deception and the very real social reactions that imply the magic is "real" on a perceptual level. For therapeutic contexts, this may act as a powerful technique for interrupting maladaptive thought patterns, thus paving the way for the therapist to help guide lasting positive change. In part, this notion of challenging limiting thought patterns is supported by our finding that participants underestimated their ability to perform the magic trick as seen in Chapter 4. This would be especially true when the actual difficulty of the magic trick is significantly lower than its perceived difficulty during the initial viewing of the unrevealed performance. Therefore, a key element of magic-based wellbeing interventions targeting self-esteem or self-efficacy should select magic tricks with a low difficulty to ensure participants are successful.

Another consideration for real-world applications is choosing the right audience for providing the social validation of the successful performance. Here we conclude that individual differences in personality only play a minor role, with extraversion being a potential candidate for an ideal audience, albeit further research is needed to confirm the real-world usefulness of this conclusion. Likewise, individual differences in curiosity would suggest that thrill seekers are more likely to enjoy the magic performance as opposed to problem solvers who enjoy magic more if they successfully figure out the secret. That said, individual differences only explained a small amount of total magic enjoyment, suggesting that most audiences would be adequate in providing social validation for magic interventions.

More important than individual differences, however, was the perceived impossibility of the tricks chosen for the intervention. Here, we conclude that tricks scoring higher on "perceived impossibility" would be more enjoyable and hence be more beneficial for teaching in magic-based wellbeing. To aid in determining which tricks are more impossible, future

research could focus on examining perceived impossibility for a variety of different magic tricks and how this perceived impossibility evolves over time. Practitioners could benefit from gathering data on perceived impossibility and difficulty level for a variety of tricks. Once established, the ideal tricks would contain both the lowest difficulty scores and the highest impossibility scores. For a deeper understanding of the mechanisms of magic enjoyment, similar experiments could be done in determining the most relevant emotions that characterize the experience of watching magic.

Learning to perform magic is an act of achieving what seems to be impossible. The process acts as an initial catalyst in challenging one's own limitations by creating an internal conflict between knowing that the trick being performed is fake and the very real social reactions that imply the magic is "real" on a perceptual level. This feeling of successfully achieving something "impossible" (i.e. learning the magic trick) is further validated by the social reaction to the magic trick. The key to understanding this social reaction lies in understanding the experience of watching magic, which depends slightly on the audience's personality, but more so on how the audience perceives it as something seemingly impossible. The experience might be characterized by wonder, which I conclude is different than the psychological construct than awe and has yet to be explored in the field of psychology. The concept of achieving what seems to be impossible was common throughout this thesis. I started with the process of learning a trick that was earlier perceived as impossible, and subsequently explored the nature of watching such impossible magic tricks that validate a magician's performance. Much remains to be explored in this new field of magic and wellbeing. My hope is that this thesis has helped to inspire a more openminded view toward learning how humans make the seemingly impossible become possible; not only in the lives of individuals but more importantly in society at large.