Quincy Ryan
Dr Rodger
UWP 104E
September 13 2024

Executive Function Enhancement in Young Adults:

A Literature Review with a Call for Integrated Wellnesss and Actionable Templates.

1. Introduction

Young adulthood poses challenges that require our best ability to self regulate, learn, and plan. Young adults often lack self supporting skills and resources. As a young adult, there is a need to know what to optimize for, what to sacrifice and bolster for the best decision making using our executive function (EF). Executive function and its improvement is a broad field. The majority of the literature is aimed toward the aging and developing populations. This paper only deals with literature concerning young adults that have: 1. No or only mild cognitive/learning disability. 2. Access to a computer with no additional equipment. 3. Access to basic health care: no access to non-essential clinical interventions. 4. Limited financial resources. The paper will then synthesize these most effective of the resources accessible to this demographic.

First, this literature review will also discuss the challenges associated with research with executive function improvement. Executive function is quite difficult to operationally define and measure. Although there are overall many studies concerned with this demographic, very few substantial conclusions have been made across the literature beyond our ‘mundane’ essential needs like nutrition, and sleep. Those methods that are promising are usually geared toward a subset of executive functioning and must be done in a very specific way to be effective.

Ultimately, the literature shows some methods that have effects in improving EF, but are ultimately eclipsed by the need for integrated physiological, psychological, and social wellness. The paper will conclude with a longer discussion of the worth of study and value of EF optimization in neurotypical/healthy adults. This paper features an appendix with templates outlining specific, simplified, and actionable *advice* on integration of helpful practices in daily life.

2. Background

2.1 Defining Executive function.

Executive function (EF) is a set of cognitive processes that underlies academic and professional success through better decision making and self regulation. There is a strong desire among many to optimize and improve executive function to improve quality of life and success. The study of EF has undeniable utility, but is quite challenging to define and measure.

There are many different conceptual and operational definitions throughout the literature. All definitions subdivide EF into multiple sub-processes. The most common in the research is 3 parts: 1. Working memory, 2. Inhibition, 3. Shifting. Some define working EF, but with slight variation. For example, Ludyga and colleagues' 2023 meta-analysis on exercise and cognitive train's effects on EF in young to middle aged adults accepted both the conventional three part definition of EF, and a truncated definition including just working memory and inhibitory control. Karchbach and Kay's general review of EF training (2021) accepted a definition of multitasking, inhibition, and cognitive flexibility. Inhibition remains the same, and cognitive flexibility and shifting are effectively the same. Multitasking and working memory are related but distinct. Many studies rely on working memory being a significant part of the EF complex and see the greatest effects of EF improvement/optimization in working memory (Ludyga et al., 2023; Blair, 2017; Warsaw et al., 2021). Some argue that working memory is improved independently of overall EF, so might be an overlapping but separate construct. Other definitions starkly diverge from the 3 part model. Although inconvenient, alternative compositions are well justified and compelling. The 3 part model is assumed in this paper. Other possible EF subcomponents, such as attention, are mentioned. Even when not accepted as a subcomponent of EF, they are generally closely related to or influence EF. An appreciation of the complexity and ambiguity of executive function is helpful when reviewing the literature.

2.2 Challenges of research methods and validity.

There is a large array of tasks and batteries designed to measure executive function. There is no set that is respected as the most effective or standard, so the EF and its subcomponents' *capture* is very inconsistent. Researchers need to coordinate to standardize their methods, or else the field will continue to be methodologically 'messy' (Baggetta & Alexander, 2016). It is also difficult to differentiate between task specific skills and global skills in EF measuring and improvement (Karbach & Kray, 2021). A

task that aims to measure EF's subcomponent working memory through visual tasks might only sharpen visual acuity. A test after a period of training might lead to conclusions that working memory has been improved, when only visual acuity has been improved.

Much of the research seems highly subject to sample bias, especially meditation and mindfulness (Cásedas et al., 2020; Yakobi et al 2021). Some subfields have more potential for conflict of interest than others. Studies involving proctored or gamified cognitive training for EF are often conducted by or in partnership with the developer of a proprietary product. Many studies rely on reporting, which may be enmeshed in complex interactions between socio-economic, ethnic, and cultural status, affecting how participants and observers report on EF effectiveness (Parrilla et al., 2024).

Confounds are a large issue across the literature. Many cognitive training interventions are proctored by trained teachers or specialists. Some argue that the gains seen in these interventions may not come from the EF related tasks themselves, but through gains in social well-being and self esteem (Gunzenhauser & Nückles, 2021; Karbach & Kray, 2021). Potentially one of the largest issues in the field is whether or not EF gains apply to only the domain in which it was trained, or if it can be transferred universally to other unrelated tasks in a lasting and non-superficial way (Blair, 2017; Seddon et al., 2018; Diamond & Ling, 2016). All issues will be discussed in more detail within their subdomain.

2.3 The state of the research

All meta analysis and literature reviews referred to express a concern with the lack of uniformity in defining and measuring the Executive Function complex. Generalized issues are abundant, likely because of the abstract nature of the EF construct.

Although EF is quite slippery, it does seem that it can be improved. This is seen most through effects in developmental and clinical contexts. The use of pharmaceutical drugs (Zhang et al., 2023; Schifano et al., 2022), behavioral interventions in school and clinical contexts are very effective (Baggetta & Alexander, 2016). Developmental intervention is far, far more effective and efficient than training later on in life (Blair, 2017). Gains are had in EF in the greatest strides by those with deficient EF. Those who are (moderately to mildly) developmentally disabled or economically disadvantaged (mostly children) had the greatest margin of improvement (Diamond & Ling, 2016). For the demographic of young healthy adults, some researchers conclude that the methods of EF improvement are not conclusively supported or known (Blair, 2017). Others say confidently that EF can be trained, but it is unclear how well EF transfers between skills (Karbach & Kray, 2021). All studies still express the need for more research.

Many researchers dispute the value of EF optimizaiton and encourage more holistic forms of self optimization/wellness that EF could even benefit from (Jiang et al.,

2021; Anderson & Marino, n.d.; O'Rourke et al., 2020; Seddon et al., 2018; Yakobi et al 2021). Although this topic in the research is the most hypothesis and opinion heavy, it is potentially the most important area of consideration for young adults with the intention of self optimizing through improving their EF.

3. Interventions

Interventions are listed in a rough least-effective and least-accessible to most recommended ordering. There are nuances and details that make each more or less relevant, and the reader should make personal judgments integrating the complexities of their own needs, the intervention, and its research.

3.1 Drugs:

Evaluation: Not recommended for the demographic discussed (young, healthy, neurotypical adults) on the basis of accessibility and safety. Anyone with a need to enhance executive functions pharmacologically should seek diagnosis and treatment for any underlying illness or disability before other methods are considered.

Nootropics or cognitive enhancers are growing in usage by healthy subjects to improve cognitive function, including executive function (Schifano et al., 2022). Their success in the memory, learning and attention impaired population is heavily studied and supported (Zhang et al., 2023; Schifano et al., 2022). Although non-impaired people are enthusiastic and actively advocate for them, their effectiveness and safety is not firmly supported by the literature. Nootropics have been documented to cause cardiovascular, neurological and psychopathological issues. Contrary to their initial benefits, they can cause short and long term cognitive decline, addiction, and appear to cause a person's personality profile to shift. Many of these substances are controlled substances (Schifano et al., 2022). Stigma is worth discussing. Nootropics may become more viable as they are better understood. Considering the medical and legal implications, nootropics are not recommended.

3.2 Neurofeedback:

Evaluation: Not recommended for the demographic discussed on the basis of effectiveness and accessibility.

Neurofeedback is an intervention where a participant monitors their own brain waves while performing a task. A participant practices a task, and determines their success of that task based on their ability to hold a particular brain wave pattern

sympathetic to that task. Neurofeedback is effective for emotional regulation and skill-honing applications. The literature does not support meaningful or consistent success for EF. The body of evidence is generally inconclusive, and all evidence showing a meaningful effect is still underwhelming. Neurofeedback also requires expensive equipment and a high level of knowledge/expertise to be effective (Viviani & Vallesi, 2021). Neurofeedback is a compelling and flashy idea. The high skill, time and cost investment, and lack of effectiveness make this intervention unuseful and irrelevant for the average young adults' use.

3.3 Media abstinence

Evaluation: Recommended for its effects in anxiety reduction. However direct improvements on EF are not supported.

The story of media abstinence and EF is complicated. The literature is ultimately inconclusive. One study found that smart phone and screen use have shown a negative correlation with some executive functions, but improvement in others. Inhibition and decision making were worsened by more use. Working memory was sometimes improved where the user played video games and good sleep hygiene was maintained (Warsaw et al., 2021). However, correlations were found between media-multitasking and worsened anxiety, delayed gratification, and social intelligence (Warsaw et al., 2021; Seddon et al., 2018). Discussed later on, physical, social, and mental health are likely the biggest factors in EF optimization and improvement. If smartphone use and media multitasking lowers quality of life, it lowers the very thing we seek to improve by enhancing our EF, and potentially inhibits our EF indirectly.

3.4 Cognitive Training

Evaluation: Cognitive training is not discouraged, but not recommended. It is quite inaccessible, and so far research on cognitive training is largely mixed and inconclusive. If one builds a foundation with more supported methods and wants to go further with their EF optimization, then they might find value in cognitive training.

Cognitive training is the most complicated topic discussed. In short, the most successful cognitive training interventions are the least accessible, and rely on structured social/classroom contexts with expensive proprietary resources/software. The most accessible cognitive training interventions, such as gamified and app based 'brain-training apps' are the least supported in the literature. Much of the literature in cognitive training appears vulnerable to bias due to many researchers being involved in the development of these programs. Cognitive training is also not convincingly transferable to real-world tasks (Diamond & Ling, 2016; Karbach & Kray, 2021; Mayer et al., 2019).

3.4.1 Proctored/Social Cognitive training:

Successful cognitive training programs have high barriers of access through cost and context. These methods usually involve a classroom setting with well trained professionals. Some computerized training showed improvement in grade-school classrooms in ADHD students, working memory, and attention (Blair, 2017; Baggetta & Alexander, 2016). Very few conclusions have been convincingly drawn about adult populations. It is also unusual to experience focused training like this in work or school as an adult.

The most successful Cognitive training programs, like CogMed, Tools of the Mind, and Montessori require the presence of a well trained teacher or specialist. This begs the question if cognitive training tasks improve EF, or if the psychoeducation/social environment plays a larger role. It has also been challenging to draw conclusions on transfer outside of this social context (Gunzenhauser & Nückles, 2021; Diamond & Ling, 2016; Mayer et al., 2019).

3.4.2 Individual cognitive training

Individual cognitive training is cognitive training without a social context. The most common and accessible cognitive training resources for individuals are online cognitive tasks/tests, gamified cognitive tasks, and brain-training apps. Cognitive tasks are interactive experiments that are generally used by researchers to measure someone's ability in a cognitive domain, like executive function. Training these tasks, or simply doing them again and again with the aim of improving may increase that cognitive function globally. Gamified cognitive tasks are those same cognitive tasks with ‘game elements’ integrated. Game elements are essentially design choices that make a task more entertaining, stimulating, and challenging. Mayer et al. 's (2019) app ‘All you can ET’ is essentially a task switching ‘test’ with more interesting graphics/animation, progressive difficulty, and a reward system. Brain training apps are essentially multiple cognitive tasks or gamified equivalents combined into a single suite.

Participants ‘make progress’ as they use these cognitive tasks, their gamified versions, and brain training suites. It is hard to say their progress transfers to meaningful gains in executive function. Are we really training a deep and abstract system, like executive function or reaction time, or are we just training to succeed in that task, and only that task? This question is largely unsupported and must be addressed with more research. (Diamond & Ling, 2016; Karbach & Kray, 2021). There are potential issues with conflict of interest in that many Brain-training are invested in appearing effective for profitability. So far, Brain training games like luminosity do not show any benefit beyond getting better at the tasks themselves (Mayer et al., 2019). The safest

option is to choose an app or program with a completely free payment model that has been developed as a research project. A good model is Mayer et al.'s paper, where they detail and describe the development of three cognitive training apps, "Gwakkamole", "CrushStations", and "All you can ET. The Neurosape program at UC San Francisco seems promising, although they appear to be difficult to gain access to. Heavy skepticism is recommended especially when capital is involved. Prioritize other, more effective interventions.

3.4.3 In general:

There aren't strong conclusions on how well training generalized to non-classroom, non-lab, or non-app contexts (Diamond & Ling, 2016; Karbach & Kray, 2021; Blair, 2017). If we assume or find that cognitive training can transfer and generalize, the literature suggests that cognitive training is most effective on working memory (Blair, 2017; Diamond & Ling, 2016). Diamond and Ling (2016) compiled a list of principles that seem to make cognitive training most effective.

1. EF effectiveness is most likely modulated by overall time training.
2. Success of group activities and potentially solo activity is dependent on individual and communal enthusiasm.
3. EF must be continuously challenged to improve over the long term: Gamified training must increase in difficulty and stay engaging consistently to challenge EF.
4. EF must be trained continuously to maintain benefits.

3.4.4 Specific recommendation:

If one chooses to enhance EF through cognitive training, do it in a communal context proctored by a specialist. If that is not possible (which is likely), use gamified software that is designed by researchers (like those developed by Mayer and colleagues), or an n-back type task for working memory that resembles a skill important to the user as closely as possible. Refer to Diamond and Ling's previously mentioned principles in training cognitive tasks for the greatest effectiveness.

3.5 Mindfulness, meditation

Evaluation: Recommended. Mindfulness and meditation is effective and highly accessible. Mindfulness also has proximal benefits in attention and emotional regulation.

Meditation and mindfulness is also abstract and difficult to study. It is hard to define, isolate, and control. Meditation and its research is usually contextualized in a

community that has strong enthusiasm for meditation. This makes sample selection bias and creating a truly neutral control condition difficult (Yakobi et al 2021). After accounting for high potential for bias, meditation appears to have a significantly positive effect on executive function. All meta analyses reviewed have conflicting conclusions on which EF component was improved the most, but studies and reviews showed at least mild and moderate improvement in EF in general (Yakobi et al 2021; Jiang et al., 2021; Blair, 2017; Cásedas et al., 2020; Zhang et al., 2023)

Findings are quite diverse and probably depend on the type of meditation. Some improvement across multiple cognitive areas, including small (but significant) effects on attention (sometimes considered a part of EF, or important collaborator (Baggetta & Alexander, 2016)), but no significant effect on working memory (Yakobi et al 2021). Others found the greatest effect was in inhibitory control, with no effect on attention (Jiang et al., 2021). Others found medium effects in working memory (Blair, 2017; Cásedas et al., 2020) and inhibitory control, with no significance effects in task switching (Cásedas et al., 2020.). A recurrent emerging hypothesis is that improvement is based on the type of meditation task. Yakobi and colleagues hypothesized the lack of effect in working memory was because of the simplicity of the meditation. Jiang and colleagues hypothesized the lack of effect in attention was due to sessions with short duration, and strength of effects on inhibitory control was due to the pairing of physical coordination in yoga.

More research is needed, but what is known is that Meditation is worthwhile for its effects in EF. It also comes with benefits in general cognition, stress reduction (Jiang et al., 2021,), and overall sense of wellbeing (Yakobi et al 2021), which are worthwhile outcomes in themselves.

Meditation's effectiveness has similar 'rules' to that of cognitive training. Meditation is most effective based on high frequency/consistency (Yakobi et al 2021; Blair, 2017), and maximum time spent practicing overall (Zhang et al., 2023). The best practice is most likely one that is daily, lasting as long as is sustainably possible. Meditation effects are immediate, positive, and temporary (Jiang et al., 2021). So one should attempt to establish a habit that is lifelong. More speculatively, it appears that if a meditation task can be 'designed' to resemble an executive function component or task that is either especially weak or valued for that practitioner, they would derive the most value. Meditation, when combined with a coordinated exercise, as is done is yoga seems incredibly effective. Coordinative exercise will be discussed next.

3.6 Coordinative Exercise

Evaluation: Highly recommended. Coordinative exercise appears to have the strongest effect towards executive function of any other non-essential Interventions.

Coordinative, high intensity exercise, is potentially the most effective independent method for executive function enhancement. This is likely caused by activation in the motor areas of the brain, which have massive network overlap with areas associated with executive function. Coordinative exercise is also more cognitively demanding than endurance exercise, which is essentially ineffective (Ludyga et al., 2023). Coordinative exercise is most beneficial when done in high intensity and when it has a 'cognitive component', or an aspect that engages coordination and spatial cognition (Diamond & Ling, 2016). Specific examples geared toward effectiveness in EF are yoga, martial arts, and Qui Gong because of their integration of intense coordination exercise and mindfulness/meditation (Jiang et al., 2021; Zhang et al., 2023; Diamond & Ling, 2016). Ludyga and colleagues (2023) concluded that the most efficient known combination of exercise is a combination of working memory training and intense coordinated exercise. Exercise may enhance the effects of cognitive training methods or meditation. Coordinative exercise may also contribute to EF gains through reducing stress, depression, and increasing sleep quality (Jiang et al., 2021; Zhang et al., 2023). Some forms of exercise may also facilitate social well being which as discussed later is an important part of EF optimization.

3.7 Emotional and physical wellbeing.

Evaluation: Emotional health and physical well being are not only essential for maintaining baseline executive function, they seem to be the greatest underlying factor for executive function improvement overall.

3.7.1 Physiological health: Diet, sleep, stress.

Sleep and diet are a prerequisite to any attempt at optimization. All studies attempt to control for poor sleep, diet, and health since they are known to worsen EF dramatically (Parrilla et al., 2024; Warsaw et al., 2021). Inhibition appears to be an exception, and is not worsened by lack of sleep (Parrilla et al., 2024), however, lack of sleep, hunger, and stress worsened EF in general (especially working memory), global cognitive function, and an overall sense of wellbeing. (Diamond & Ling, 2016; Parrilla et al., 2024) Good sleep and nutrition give us a better sense of well being overall, and is correlated with better academic performance, and success in physical and cognitive performance (Parrilla et al., 2024). While Sleep, nutrition, and sense of well being may not *increase* our executive function, they allow us to reach our highest current potential. If one attempts to optimize or increase their EF with poor sleep hygiene, nutrition, and sense of well being, they are wasting their time, resources, and are *missing the point*.

3.7.1 Mental and social well being.

Beyond physiological well being, mental and social well being may be the largest realizers/optimizers for executive function. Massive margin of success between proctored and individual EF training is likely because of the peer and mentorship relationships that contextualized the training (Gunzenhauser & Nückles, 2021; Karbach & Kray, 2021). A meta analysis on Coaching and counseling for EF improvement by Anderson & Marino showed massively disparate and disorganized methods of psychoeducation, skill training, and cognitive training methods turn out a massive amount of success in students' EF improvement. Interventions involving mentorship and peership may allow for finer-grain adjustment in an individual's training, but might also help to reduce stigma and increase enthusiasm in EF training and tasks targeted by EF.

Loneliness and low self esteem inhibits EF (Anderson & Marino, n.d.) and negative social standing or perception could translate into stress or depression, also inhibiting EF (Diamond & Ling, 2016). Like poor physiological health, poor mental and social well being is a disqualifier for EF optimization. All methods that have been tested with a strong social context or some level of wellness integration have shown far more benefit than those without them. It could be the case that excellent mental and social health could be of benefit to EF by itself, although that will require a new body of research to support or deny.

Although social media abstinence does not appear to directly inhibit EF or any of its components, it has a strong correlation with general anxiety and social anxiety, which may have an indirect negative effect on EF (Seddon et al., 2018).

EF has a complex relationship with coping. Some forms of coping appear to be worsened by better working memory, due to a larger capability for rumination and catastrophizing (O'Rourke et al., 2020). By making mental and social well being a priority, we might be able to avoid the pitfalls of the complex relationship between EF and coping/emotional regulation.

One should aim to improve their social support network and mental health resources (internal or externally) to elevate a state of wellness that decreases inhibitions on EF improvement. Perhaps an elevated state of wellness could improve EF on its own. Although social/mental wellness are pursuits themselves, they are integratable into other interventions. Cognitive training is most effective when proctored and done with others. Success of group activities and potentially solo activity is dependent on individual and communal enthusiasm (Diamond & Ling, 2016). A meditation aimed at improving working memory would likely work best with non-judgemental and self accepting elements. A coordinative sport might yield the greatest benefit if practiced with others.

3.8 General principles and combinations

EF improvement appears to be optimal in combinations of exercise and mindfulness/cognitive training. The best known so far is coordinative exercise and training focused on working memory (Ludyga et al., 20). EF optimization must be ongoing (Gunzenhauser & Nückles, 2021; Diamond & Ling, 2016) EF optimization needs an approach to a persons' ability ceiling and practiced with high intensity, (Diamond & Ling, 2016) and consistency. (Blair, 2017; Zhang et al., 2023)

The ability to transfer from isolated training tasks is for now quite unsupported. Best thing we can do for now is make it resemble a specific task. Any cognitive training or meditation should be made to resemble a specific task as closely as possible (Karbach & Kray, 2021; Diamond & Ling, 2016; Gunzenhauser & Nückles, 2021)

4. Conclusion

Executive function is a complex and difficult to study construct. Any attempt to improve it depends on a strong foundation of physiological, mental, and social wellness. More isolated interventions are often inconclusive and forces us to rely on speculation. Although most solutions do not have strong effects, most with promise are known to increase our overall sense of wellness.

The desire to self optimize is strong amongst young adults in an effort to become better students and workers. Self optimization often seems to be derived from fear and self-commodification. Is it really worth it to optimize executive function, when it leads us to expensive, time consuming, relatively ineffective, and even dangerous methods like nootropics, neurofeedback, and computerized cognitive training? Anyone investigating EF optimization should first ask: What do I need more executive function for? Will it make me happy? Would it be better to spend time on specific skills that I need or value?

The idea of hooking ourselves up to a machine, playing a specially designed video game, or taking a pill that makes us extraordinary and able to solve our problems with ease is alluring. It may be disappointing to hear that there is no skipping good sleep, nutrition, relationships, and exercise to get to the best versions of ourselves. These parts of life sometimes appear more mundane, and are more challenging to sort out than the Sci-fi alternatives. Yes, executive function optimization past fundamental wellbeing has diminishing returns. Yes, executive function optimization is intertwined with our social, health, and psychological challenges. Perhaps this is good news. Perhaps disappointing for the highly ambitious, but great for the human kind. Attempts to elevate ourselves into socio-economic equity creates a world of physiological and psychological equity. In the case of executive function, these equities will naturally bring us to a place of cognitive equity, where those around us are more capable, more self controlling, focused, and ultimately more healthy and happy.

5. Appendix: Actionable templates and toolsets for Executive function training

Consider the previously mentioned methods and training principles to make each tool as effective as possible. These templates are suggestions integrated from common conclusions, shared hypotheses, and connections from researchers and the author. Use skepticism, experience, and more research as your guide.

Prerequisites:

These templates and their interventions will not be effective unless one has

1. Addressed underlying disabilities or illnesses in a clinical context.
2. Maintains good sleep, nutrition, and physiological health.
3. Begun the process of developing internal and external resources for psychological and social well-being.

Minimal template: “All in one”

Maintain a single practice that incorporates elements of mindfulness, coordinative exercise, socialization and wellness.

Choose a mind-body practice, such as **Yoga**, Tai chi, or martial arts, that…

1. You are **enthusiastic** about and can practice **sustainably** and **consistently**.
2. Has a **strong social/cultural context** with values of **emotional**, and **physical well-being**.
3. Can be **modulated** in **intensity**: Yoga has gentler variations that can be used for stress relief, and high intensity variations.
4. Has high **coordinative demands**.
5. Has a **meditation** component.

Diversified template: The “Tool box”

Build a ‘Toolset’ where different skills can be practiced in rotation, or used and applied based on a particular need or challenge. All must be chosen with consistently, sustainably, socially, and enjoyment in mind.

1. **Coordination heavy sport that is enjoyable and compelling**:
   Karbach & Kray (2021) recommends "ultimate Frisbee, squash, tennis, rock climbing, pickup football, soccer, beach volleyball, social dance or martial arts". Other high intensity sports include olympic weightlifting, gymnastics, pickleball, tricking, and calisthenics.
2. **Mindfulness meditation practice**: Zen, vipassana meditation, transcendental, yogic, etc.
3. **Social outlet**: Some sort of activity or consistent contact with a community. These can have overlap with your sport.
4. **Practice valued skills directly**: If EF is meant to make us more effective in our work, school, hobbies, and obligations, there is no substitute for practicing and getting more effective by doing them.
5. (Bonus) Cognitive training app through research-derived principles.

General considerations. .

- Prioritize sustainability and consistency above all.
- Access these skills and practices to prepare for or recover from cognitively demanding tasks.
- Do NOT engage in a maximalist routine: If EF is used to improve a particular skill, one should consider practicing the skill directly instead.
- Draw inspiration from the templates. Consider finding an 'inbetween' that works well for you

---

Bibliography

Anderson, K., & Marino, M. T. (n.d.). *Executive Function Coaching for College Students with Disabilities: A Systematic Literature Review*.

Antón, E., Carreiras, M., & Duñabeitia, J. A. (2019). The impact of bilingualism on executive functions and working memory in young adults. *PLOS ONE*, *14*(2), e0206770. https://doi.org/10.1371/journal.pone.0206770

Baggetta, P., & Alexander, P. A. (2016). Conceptualization and Operationalization of Executive Function. *Mind, Brain, and Education*, *10*(1), 10–33. https://doi.org/10.1111/mbe.12100

Blair, C. (2017). Educating executive function. *WIREs Cognitive Science*, *8*(1–2), e1403. https://doi.org/10.1002/wcs.1403

Cásedas, L., Pirruccio, V., Vadillo, M. A., & Lupiáñez, J. (2020). Does Mindfulness Meditation Training Enhance Executive Control? A Systematic Review and Meta-Analysis of Randomized Controlled Trials in Adults. *Mindfulness*, *11*(2), 411–424. https://doi.org/10.1007/s12671-019-01279-4

Diamond, A., & Ling, D. S. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience*, *18*, 34–48. https://doi.org/10.1016/j.dcn.2015.11.005

Georgiou, G. K., & Das, J. P. (2018). Direct and indirect effects of executive function on reading comprehension in young adults. *Journal of Research in Reading*, *41*(2), 243–258. https://doi.org/10.1111/1467-9817.12091

Gunzenhauser, C., & Nückles, M. (2021). Training Executive Functions to Improve Academic Achievement: Tackling Avenues to Far Transfer. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.624008

Jiang, D., Liu, Z., & Sun, G. (2021). The Effect of Yoga Meditation Practice on Young Adults' Inhibitory Control: An fNIRS Study. *Frontiers in Human Neuroscience*, *15*. https://doi.org/10.3389/fnhum.2021.725233

Karbach, J., & Kray, J. (2021). Executive Function Training. In T. Strobach & J. Karbach (Eds.), *Cognitive Training: An Overview of Features and Applications* (pp. 199–212). Springer International Publishing. https://doi.org/10.1007/978-3-030-39292-5_14

Ludyga, S., Held, S., Rappelt, L., Donath, L., & Klatt, S. (2023). A network meta-analysis comparing the effects of exercise and cognitive training on executive function in young and middle-aged adults. *European Journal of Sport Science*, *23*(7), 1415–1425. https://doi.org/10.1080/17461391.2022.2099765

Luo, J., Yeung, P.-S., & Li, H. (2022). Impact of media multitasking on executive function in adolescents: Behavioral and self-reported evidence from a one-year longitudinal study. *Internet Research*, *32*(4), 1310–1328. https://doi.org/10.1108/INTR-01-2021-0078

Mayer, R. E., Parong, J., & Bainbridge, K. (2019). Young adults learning executive function skills by playing focused video games. *Cognitive Development*, *49*, 43–50. https://doi.org/10.1016/j.cogdev.2018.11.002

O'Rourke, E. J., Halpern, L. F., & Vaysman, R. (2020). Examining the Relations Among Emerging Adult Coping, Executive Function, and Anxiety. *Emerging Adulthood*, *8*(3), 209–225. https://doi.org/10.1177/2167696818797531

Parrilla, M. M., Kautiainen, R. J., & King, T. Z. (2024). Sleep quality and executive function in a diverse sample of healthy young adults. *Applied Neuropsychology: Adult*, *0*(0), 1–9. https://doi.org/10.1080/23279095.2023.2297299

Schifano, F., Catalani, V., Sharif, S., Napoletano, F., Corkery, J. M., Arillotta, D., Fergus, S., Vento, A., & Guirguis, A. (2022). Benefits and Harms of 'Smart Drugs' (Nootropics) in Healthy Individuals. *Drugs*, *82*(6), 633–647. https://doi.org/10.1007/s40265-022-01701-7

Seddon, A. L., Law, A. S., Adams, A.-M., & Simmons, F. R. (2018). Exploring the relationship between executive functions and self-reported media-multitasking in young adults. *Journal of Cognitive Psychology*, *30*(7), 728–742. https://doi.org/10.1080/20445911.2018.1525387

Viviani, G., & Vallesi, A. (2021). EEG-neurofeedback and executive function enhancement in healthy adults: A systematic review. *Psychophysiology*, *58*(9), e13874. https://doi.org/10.1111/psyp.13874

Warsaw, R. E., Jones, A., Rose, A. K., Newton-Fenner, A., Alshukri, S., & Gage, S. H. (2021). Mobile Technology Use and Its Association With Executive Functioning in Healthy Young Adults: A Systematic Review. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.643542

Yakobi, O., Smilek, D., & Danckert, J. (2021). The Effects of Mindfulness Meditation on Attention, Executive Control and Working Memory in Healthy Adults: A

Meta-analysis of Randomized Controlled Trials. *Cognitive Therapy and Research*, *45*(4), 543–560. https://doi.org/10.1007/s10608-020-10177-2

Zhang, Z., Chang, X., Zhang, W., Yang, S., & Zhao, G. (2023). The Effect of Meditation-Based Mind-Body Interventions on Symptoms and Executive Function in People With ADHD: A Meta-Analysis of Randomized Controlled Trials. *Journal of Attention Disorders*, *27*(6), 583–597. https://doi.org/10.1177/10870547231154897