

Nootropics: Physical Performance Gets a Cognitive Boost—Cognitive Enhancers, Smart Drugs, Cosmetic Neurology

The lines of legality and acceptability of substances that result in physical enhancement or enhanced performance via enhanced physicality of the user are fairly clearly drawn. However, there is a growing trend towards using a class of substances that claim to provide a "cognitive boost" (more focus, longer attention span, memory, alertness, quicker reaction/response times, improved motivation or elevated mood) to enhance not only physical sports/athletic performance but also including a wide range of activities demanding high cognitive function such as studying in college or tactical operations (Frank & Orwell, 2013). Nootropics ("smart drugs", cognitive enhancers) range from prescription substances to those accessible over-the-counter (consumer nootropics). Consumer nootropics remain largely untested and unregulated with regards to dosage levels, active ingredients, "stacking", and drug interactions due to the fact they are classed as "dietary supplements".

The most documented and deemed "reliable" (regarding consistent effects) nootropic is caffeine (Cakic, 2009). It is also commonly stacked (using supplements in combinations) as found in popular brands claiming to improve athletic performance such as Nutrabolics FIGHT FACTOR™, MRM™ CRAM, and MusclePharm's Assault™ (via ChromaDex's PurEnergy™, high-potency, slow-absorption formulation). As noted by Cakic (2009), caffeine "reliably increases performance in a range of sports" (p. 613) and that it is "an exemplar nootropic whose use is both safe and culturally endorsed" (Cakic, 2009, p. 614).

Santos et al. (2014) summarized that previous studies demonstrated that caffeine was generally found to consistently improve power, speed, agility, attention, and reaction time. In the study by Santos et al. (2014) on the reaction times of Taekwondo athletes during a Bandal Tchagui (single kick to the opponents abdominal area) exercise on go-signal, caffeine was likely to have improved the reaction times. In the mock-contest simulation with Taekwondo athletes, Santos et al. (2014) found similar results and additionally attributed increased intensity and delayed fatigue to the effects of caffeine.

Duvnjak-Zaknich, Dawson, Wallman, and Henry's (2011) study was the first to examine caffeine's effects on reactive agility which has a direct correlation to sports-specific skills, especially those that require a quick change in direction in response to a stimulus. Duvnjak-Zaknich et al. (2011) found that caffeine likely improved the reactive agility test via decision-making accuracy with subjects both "fresh" and fatigued.

As previously mentioned, caffeine is commonly stacked with other supplements. Caffeine, taurine, and glucose are found in many popular energy drinks. Giles et al. (2012) found that in simple and choice reaction tests involving colored targets, caffeine aided in reducing the reaction times while taurine seemed to improve the accuracy of the choice reaction tasks. However, taurine was not found to lower the reaction times for either simple or choice tasks. Giles et al. (2012) concluded that their results showed that the benefits of caffeine were consistent with other studies, but that the benefits of taurine (and taurine stacked with caffeine) were inconclusive and needed further study.

L-theanine and caffeine are found naturally in tea. Foxe et al. (2012) examined the effects of caffeine and l-theanine in a sustained attention to response task (SART) where participants in the study were instructed to respond only to certain numbers appearing on the monitors and withhold responding to the number 3. Foxe et al. (2012) found that caffeine (taken alone) reduced reaction times as well as reduced commission/omission errors. Foxe et al. (2012) found that theanine taken alone also reduced commission/omission errors but that theanine (taken alone) did not improve upon the participant's reaction times. Foxe et al. (2012) found that the caffeine-theanine combination reduced commission/omission errors by the same amount as if either caffeine or theanine were taken alone. Furthermore Foxe et al. (2012) did not find that this combination significantly reduced reaction times per stimuli, but that it did show a reduction in reaction time overall (by the end of the participant's session). Foxe et al. (2012) summarized that it seemed likely that the benefit from the caffeine-theanine combination was improved accuracy and vigilance.

Similarly, Giesbrecht, Rycroft, Rowson, and De Bruin (2010) found the combination of caffeine and theanine to enhance focus, attention, and alertness when their participants performed choice-reaction-time task, visual-search task, egocentric mental-rotation task, and attention-switching task. Owen, Parnell, De Bruin, and Rycroft's (2008) study also found that the combination of caffeine and l-theanine improved reaction times and accuracy. Furthermore, Owen et al. (2008) suggested that the caffeine-theanine combination significantly improved memory and attention in tasks versus using caffeine alone. Owen et al. (2008) noted that l-theanine may "regulate" some of the stimulatory effects of caffeine and that l-theanine and caffeine seemed to exhibit a synergistic relationship but further studies would be warranted.

MusclePharm's Assault™ is a popular pre-workout supplement. The study by Spradley et al. (2012) concluded that not only did Assault™ improve energy, focus, and alertness, but that there was a "significant improvement in multi-directional choice reaction time and single-step choice reaction time with an auditory stimulus" (p. 8). In the formulation of Assault™ studied by Spradley et al. (2012), caffeine anhydrous (concentrated caffeine not in water) and camellia sinensis (white tea leaf powder) were listed among the ingredient category labeled "High Performance Energy & Intensity Amplifier". As previously mentioned tea, with camellia sinensis being no exception, contains both caffeine and l-theanine. A newer formulation of Assault™ lists ChromaDex's PurEnergy™ (pterostilbene-caffeine) as the "caffeine" component that replaces the caffeine-theanine stack in the original formula.

MRM™ CRAM is another nootropic that advertises enhanced cognitive function. Hoffman et al. (2010) found the vitamins found in CRAM were not ergogenic (in subjects who were not deficient), but rather the advertised energy-matrix of caffeine and tyrosine. Choline and phosphatidylserine combined with caffeine and tyrosine may have been more likely to "maintain reaction performance following fatigue" (Hoffman et al., 2010, p. 6). The study by Hoffman et al. (2010) concluded that "acute ingestion of CRAM can prevent the exercise-induced decline of reaction time, and subjective feelings of focus and alertness" (p. 6). Hoffman et al. (2010) also noted that CRAM may be habit-forming.

While studies are limited, worth noting are substances DHA (docosahexaenoic acid, omega-3 fatty acid) from cold water fish and policosanol (policosanol) which comes from sugar cane wax (Antonio, 2003).

Stonehouse et al. (2013) conducted a Stroop test to observe the effects of DHA supplementation and found that DHA seemed to improve memory and reaction times in healthy young males who were previously slightly deficient in DHA in their dietary intake. Guzmán et al. (2011) studied the reaction times of female elite soccer players in complex reaction time test using both auditory and visual stimuli. The soccer players were instructed to withhold response on certain combinations of stimuli. Guzmán et al. (2011) concluded that DHA seemed likely beneficial in sports requiring decision-making and quick reaction times.

Policosanol (policosanol) comes from sugar cane wax (Antonio, 2003) and it is mostly known to lower cholesterol. An additional observed of policosanol (active ingredient octacosanol) effect was improved reaction time to visual stimulus and grip strength (Antonio, 2003). Octacosanol (from sugar cane wax) and isopolicosanol (from wheat germ oil) in the study by Fontani, Maffei, and Lodi (2000), were found to improve reaction time with isopolicosanol being the most effective.

The debates on supplementation's legality or effectiveness are extremely difficult to navigate. Further extensive studies need to be done in order to provide definitive answers to the consumers regarding dosage, safety, and drug-interaction effects. Thus far, caffeine seems to be the most "proven" and most consistent in how it affects performance. Caffeine is also known to be stacked with other ingredients found in performance substances including pre-workout formulas and consumer nootropics.

Interestingly, Alpha BRAIN™ by Onnit Labs (<https://www.onnit.com/alphabrain/>) advertises that it does not contain caffeine. However, the label does list l-theanine and pterostilbene (a component found in blueberries) as significant ingredients in their stack. Previously discussed, both l-theanine and pterostilbene have been stacked with caffeine in other supplement products.

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