How a Healthy Liver Can Assist your ASD Child
By Stephanie Ray, Tami Wilken, Teri Woods, CCN, CCH

The liver is one of our kids biggest allies in assisting with nutrient absorption, filtering out yeast, bacteria and viral. It is also the organ largely responsible for ridding the body of toxins such as lactic acid, PCB’s, pesticides, and heavy metals, as well as decreasing ammonia in the body. By improving your child’s liver structure and function, you can see improvements in their cognitive abilities, social skills and gastrointestinal functions.

Interesting Facts about the Liver

• The liver filters up to two quarts of blood a minute.
• It is the largest organ in the body. In an adult, it weighs about three pounds and is roughly the size of a football.
• The liver performs over 500 different chemical functions and affects nearly every physiological process of the body.
• More heat is produced by the liver than by any other organ in the body.
• The liver is among the few internal human organs capable of natural regeneration of lost tissue; as little as 25% of remaining liver can regenerate into a whole liver again.
• The liver produces more proteins than any other organ in the body.
• Overeating is a common cause of liver malfunction because it creates excessive work for the liver, and an overworked liver can’t properly detoxify harmful substances.
• 25,000,000 Americans- one in every 10 are afflicted with liver related diseases each year.
• It is only the liver that can purify the bloodstream.
• The liver is the most active organ in the body during detoxification.
• Chinese doctors have long considered the liver to be the most important organ in the body- they call the liver the “General of the Army.”
• You cannot live without a liver.
Primary Functions of the Liver

- stores and mobilizes energy
- controls blood sugar (glucose)
- regulates glycogen (body’s main source of stored energy)
- regulates fat storage
- aids digestion
- produces bile (yellow-green liquid that helps to excrete waste and digest fat)
- produces urea (the main substance of urine)
- manufacturers clotting factors & regulates blood clotting
- produces several (non-reproductive) hormones
- manufactures cholesterol (it produces about 80% of the cholesterol in your body)
- filters the blood
- eliminates bacteria
- metabolizes toxins (drugs, toxic metals, pesticides, etc.)
- stores vitamins A, D, and B12
- stores minerals and iron
- produces essential immune system factors
- monitors and manufacturers countless other blood proteins to maintain the proper levels of numerous chemicals in the body
Metabolic Functions of the Liver
Specifically: the breakdown of food and its transformation into energy

How the liver breaks down carbohydrates
• The liver plays a key role in assuring carbohydrate homeostasis (dynamic balanced conditions) by removing simple sugars from the general circulation after ingestion of food and storing them as glycogen.
• Glycogen is broken down between ingestion of food which tends to maintain blood sugar levels.
• When glycogen stores are exhausted, it is capable of converting non carbohydrate metabolites such as amino acids and fats into glucose to maintain blood sugar levels.

How the liver breaks down fat
• The liver is extremely active in oxidizing triglycerides to produce energy.
• It is where the bulk of the lipoproteins are synthesized.
• It converts excess carbohydrates and proteins into fatty acids and triglycerides, which are then exported and stored into adipose (fat) tissue.
• The liver synthesizes large quantities of cholesterol and phospholipids. Some of this is packaged with lipoproteins and made available to the rest of the body. The remainder is excreted in bile as cholesterol or after conversion to bile acids.

How the liver breaks down protein
• Digested proteins in the form of amino acids are broken down further in the liver by deamination (the process by which amino acids are broken down).
• The liver is responsible for synthesis of non-essential amino acids as well as most of the plasma proteins.
• Albumin, the major plasma protein, is synthesized almost exclusively by the liver.
• Synthesis of urea leads to removal of ammonia. (Ammonia is very toxic and if not rapidly and efficiently removed from circulation, it will have adverse impact on the central nervous system.)

About Phase One Liver Detox Pathway
• The liver converts a toxic chemical into a less harmful chemical. This is achieved by various chemical reactions (such as oxidation, reduction and hydrolysis).
• Excessive amounts of toxic chemicals such as pesticides can disrupt the enzymes system (P450) of this pathway by causing over activity or ‘induction.’ This will result in high levels of damaging free radicals being produced.
• Free radicals are unstable particles that react with the body and damage the body’s cells. If too many free radicals are made, they can hurt the liver cells.
• In order to get rid of or reduce these free radicals, our bodies need foods with a lot of antioxidants and phytochemicals. The antioxidants Vitamin A, C, E, selenium and many different phytochemicals are found in fruits, vegetables and whole grains—indoles from cruciferous vegetables and quercetin have been shown to support Phase One of liver detoxification.
• Substances that may cause over activity during phase one: caffeine, dioxin, saturated fats, organophosphorus pesticides, paint fumes, sulfonamides, exhaust fumes,
pharmaceutical.

• The metabolites from this detoxification process are often potentially more harmful than their original toxic compounds. It is important for health that these toxic compounds not be allowed to build up. This is where Phase II of liver detoxification comes in.

**About Phase Two Liver Detox Pathway**

This is called the conjugation pathway, where the liver cells add another substance (e.g., cysteine, glycine, or a sulphur molecule) to a toxic chemical or drug to render less harmful. The conjugation molecules are acted upon by specific enzymes to catalyze (or accelerates) the reaction step. Through conjugation, the liver is able to turn drugs, hormones, and various toxins into excretable substances. The toxin or drug becomes water-soluble, so it can then be excreted from the body via watery fluids such as bile or urine. For efficient phase two detoxification, the liver cells require sulphur-containing amino acids such as taurine and cysteine. Eggs and cruciferous vegetables (e.g., broccoli, cabbage, brussels sprouts, cauliflower) and raw garlic, onions, leeks and shallots are all good sources of natural sulphur compounds to enhance phase two detoxification. Thus these foods can be considered to have a cleansing action.
Inefficient Detox Pathways:

If the phase one and phase two detoxification pathways become overloaded, there will be a build up of toxins in the body.

- Many of these toxins are fat soluble and incorporate themselves into fatty parts of the body where they may stay for many years.
- The brain and the endocrine (hormonal) glands are fatty organs and are common sites for the fat soluble toxins to accumulate.
- Symptoms may include brain dysfunction, hormonal imbalances and adrenal gland exhaustion.
- A sluggish liver can cause copper to build up in the tissues.
- It is possible to have an increase in detox reactions, “healing crisis” if you are trying to detox with a congested liver.

What is “Leaky Gut” Syndrome?

The lining of our intestines is meant not only to absorb food, but to act as a barrier to keep out invading pathogens, including microorganisms and undigested proteins. When the digestive tract (also known as the intestinal mucosa) is inflamed and begins to lose its integrity, you can develop what is called a “leaky gut”.

![A Healthy Mucosa Wall](image1.png) ![A Leaky Mucosa Wall](image2.png)

Healthy mucosa allows nutrients to pass the barrier while blocking the entry of toxins. With leaky gut, the barrier is dysfunctional, blocking nutrients at the damaged villi while permitting toxins to enter the blood stream.

“Leaky Gut” and the Liver

Here is what can occur between leaky gut and an over burdened liver illustrating the relationship between the health of the intestinal tract and liver function.

- Large food molecules, bacteria, fungi, parasites, and their toxins and waste can pass straight into the bloodstream and be presented to the liver for detoxification.
- The metabolic and microbial toxins that enter the bloodstream during leaky gut end up in the liver, which has the job of detoxifying and discharging the poisons. Under normal conditions, the liver is taxed just by processing the daily metabolic wastes created by cell and organ activity.
- When dumping of intestinal toxins occurs on a regular basis, the liver becomes
saturated. It cannot further detoxify the poisons, and they are returned to the blood for circulation.

- The blood has sophisticated mechanisms for preserving chemical homeostasis, and will diffuse as much of the toxic chemicals and physical debris into the interstitial fluids as is possible.
- This is when the door is open to let the bacteria, viruses, parasites and fungus in even undigested food molecules, which can then activate the immune system and also the autoimmune system.
- When the immune system reacts to them, immune complexes are formed and these complexes travel to the liver where they are broken down.
- This stresses the liver and its detoxification capability. As a result these substances may be partially processed and accumulate in the liver and adipose (fatty) tissue.
- From here the lymphatic system will attempt to collect and neutralize the toxins, but unable to send the toxins to the liver, the body essentially becomes toxic.

**The Immune System Response**

When the digestive system isn’t functioning correctly, the cells cannot get the nutrients they need or eliminate wastes. The immune system goes on alert, working double duty.

If filtering and/or detoxification systems within the liver are overloaded or inefficient; toxins, dead cells, and microorganisms build up in the blood stream. The immune system starts making antibodies against these larger molecules because it recognizes them as foreign, invading substances that need to be destroyed. The immune system will then produce excessive inflammatory chemicals, and in some cases, auto antibodies, because it is in a hyper-stimulated state. The immune system becomes overloaded and irritated. When the immune system is required to run on “high” on a regular basis, it may be spread thin over a wide array of territory defending the gut, cleaning the blood, fighting inflammation, warding off pathogens, and so on.

**Who’s Putting Ammonia in My Liver?**

A very wide range of the toxic substances produced in a toxic bowel is sent on to the liver, which is the body’s primary detoxification site. During the digestion of proteins, a number of harmful bacteria, including Clostridia, Eubacteria, and Peptostreptococci produce toxic ammonia in the gastrointestinal tract. It is the result of a perfectly normal process. A healthy liver detoxifies the ammonia by turning it into urea, which is passed out of the body in the urine. However, if the liver is not working properly (Leaky Gut), the ammonia remains unprocessed and enters the bloodstream and invades the central nervous system causing many dangerous systems. The brain is affected.

**Symptoms of Excess Ammonia in the Brain Include:**

- Lethargy
- Seizures
- Ataxia (a failure of muscle control in arms and legs, resulting in a lack of balance and coordination or disturbed gait)
- Unclear thinking
• Extreme Sleepiness
• “Spinning Thoughts” i.e. repeating thoughts
• OCD type behaviors
• Forgetfulness
• Trouble Concentrating
• Confusion
• Agitation

Ammonia
The liver converts ammonia to urea, which is excreted into the urine by the kidneys. In the presence of severe liver dysfunction or liver disease, ammonia accumulates in the blood because of both decreased blood clearance and the decreased ability to form urea.

Some Solutions to High Ammonia Levels
• Multi strain probiotics are helpful in treating an unhealthy liver by preventing the absorption of ammonia from the colon. This shows again the strong relationship between the liver and the gut.
• When probiotics reach the intestines, they are welcomed by the friendly bacteria as a good food source. Through fermentation, the bacteria turn probiotics into lactic and acetic acids. This has the natural effect of reducing the pH level of the large intestine, making it far more acidic. When a high level of acidity is present the ammonia remains in its ionized form. In this form, it is not passed on to the liver or diffused into general circulation through the blood. This reduces the toxic load on the liver and reduces ammonia levels throughout the body, including the brain.
• Drain acids and therefore ammonia via an acidic pH urine (5.5-5.8)
• Alkalize saliva with alkalizing greens, which increases oxygen and cleans the blood.
• Fresh lemon and water. Lemon juice will always be thought of as an acidic substance, but while fresh, is anionic, which corresponds to alkaline.

The Liver and Emotions
A key factor in healing often lies in the ability to reduce the emotional burden of the liver, which improves the liver’s capacity to carry out its many functions including detoxification and replenishment of the blood. The emotions and the physical work go hand in hand: when the liver is healthy, the emotions flow smoothly; but when the liver is stagnant, the emotions become irrational. The emotional will affect the physical and vice-versa.

What is the Impact of a Congested Liver?
• yeast and bacterial infections
• food intolerances/allergies
• significant decrease in absorption of nutrients from food and supplements
• decrease in verbal and non-verbal communication skills
• impaired digestive function
• decreased cognitive ability
• lack of focus
• sensory overload
• emotional outbursts
- skin rashes/conditions (i.e. eczema)
- high first morning urine pH

Benefits of Testing Liver Function
Liver Enzyme Tests

A variety of factors can increase liver enzyme levels including drugs, infections, toxins or trauma. When liver damage occurs, the enzymes are released in stages. When all of these enzyme levels begin to decline, it is a sign that the damaged liver is beginning to heal.

Measuring a single enzyme level will not diagnose a condition, but a combination can provide valuable information to help in the diagnosis and management of various conditions.

Enzyme testing may be done either as a part of making an initial diagnosis or to monitor the progress of a treatment for an existing disorder. Some conditions will require a series of regular enzymes tests over time.
Understanding Liver Panels

- **SGPT (Serum glutamate pyruvate transaminase)** - an enzyme found within the liver cells. An elevated level indicates that the liver cells are either leaky (internal contents are entering the blood) or damaged.

- **ALT (alanine aminotransferase)** - an enzyme found primarily in the liver but also to a lesser degree, the heart and other tissues. When such damage occurs, ALT is released from the liver cells into the bloodstream. It is useful in diagnosing liver function more so than SGOT levels.

- **AST (aspartate aminotransferase)** - an enzyme found primarily in the liver, heart, kidney, pancreas, and muscles. With tissue damage present, especially heart and liver, this enzyme is normally elevated. Vitamin B deficiency is an instance where this enzyme may be decreased.

- **SGOT (serum glutamic-oxaloacetic transaminase)** – an enzyme found in the liver, muscles (including the heart cells), and red blood cells. It is released into the blood when cells that contain it are damaged. Other names for this enzyme are aspartate aminotranskinase, aspartate transaminase, and AST.

- **GGT (gamma-glutamyltransferase)** - involved in the transport of amino acids and peptides into cells as well as glutathione metabolism. GGT is mainly found in liver cells. Elevated levels may be found in liver disease, alcoholism, bile-duct obstruction, drug abuse, and in some cases excessive magnesium ingestion. Decreased levels can be found in hypothyroidism, hypothalamic malfunction, and low levels of magnesium. Normal levels: 1 to 4 years old - 6-19mg/dl, 4 to 7 years old - 10-22mg/dl, 7 to 12 years old - 13-30mg/dl

- **AP (alkaline Phosphatase)** - produced in the cells of the bone and liver with some activity in the kidneys, intestine, and placenta, it is mostly found in an alkaline state with a pH of 9. Growing children may have higher levels of this enzyme. Low levels are sometimes found in hypoadrenia, protein deficiency, malnutrition, and a number of vitamin deficiencies. Normal Children’s Range- 40- 400 U/L

- **Eosinophils** - used by the body to protect against allergic reactions and parasites. Elevated levels may indicate an allergic response. A low count is normal.

- **LDH (lactate dehydrogenase)** - LDH is an enzyme found in many body tissues, including the liver. Elevated levels of LDH may indicate liver damage.

- **PT (prothrombin time)** - This test measures the clotting time of plasma. Increased PT may indicate liver damage.

**What is an OAT test?**

- This is one lab test that yields important information about patients’ overall state of health. Developed to access efficiency of cellular energy production, metabolic toxicity problems/detoxification and neurotransmitter metabolism. In addition, this analysis provides important information about clinically significant gut flora imbalances by detecting elevated levels of metabolic waste products from bacteria and yeast.

- **Use** - Urine organic acid testing is useful in the diagnosis and monitoring of patients with inborn errors of organic acid metabolism, inborn errors of amino acid metabolism, urea cycle defects, and defects of the mitochondrial respiratory chain.
• **Limitations** - Organic acid analysis may fail to detect certain disorders that are characterized by minimal or intermittent metabolite excretion.

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**OAT?**

*What Is the Organic Acid Urinary Analysis - OAT?*

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**Limitations** - Organic acid analysis may fail to detect certain disorders that are characterized by minimal or intermittent metabolite excretion.

Using Liver Life™ patient sees improvement in Organic Acid Test due to an increased function of the liver.

<table>
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<tr>
<th>TEST</th>
<th>BASELINE LAB TEST</th>
<th>8 MONTHS LATER</th>
<th>NORMAL VALUE RANGE</th>
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*This child’s baseline OAT was taken prior to the introduction of Liver Life™, the post test results are after 8 months of using Liver Life™

• **Liver Life™ enabled this child to decrease yeast, bacteria, and oxalic acid, increase absorption of vitamins and normalize excessive fatty acid oxidation.**

- The changes in hippuric, 2-hydroxybutyric, and VMA suggest that this child was able to significantly decrease bacteria levels to a healthy range.*
- The changes in glycolic and oxalic suggest that this child was able to decrease yeast, and oxalic acids.*
- The Vitamin Indicators show that this child had a deficiency in all listed vitamins.*
- After using Liver Life™ those vitamin levels were significantly increased.*
- The Fatty Acid Metabolites indicate that ketones were being produced due to excessive fatty acid oxidation.*
- After using Liver Life™ the levels of ketones are in, or much closer to, a healthy range.*
- The elevated values of 2-hydroxyisovaleric may be due to deficiencies of the vitamins thiamine or lipoic acid. After using Liver Life™ these elevated levels are now within normal range.*

**Liver Life for the revitalization of healthy liver function.™**

To order, please call: (888) 635-9582

*These statements have not been approved by the FDA. This product does not intend to diagnose, treat, cure, or prevent any disease.

**BioRay Inc.** *(949)305-7454 www.biory2000.com*  
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More Liver Function Tests

**Bilirubin**
A byproduct of the breakdown of the red blood cells in the liver, bilirubin is a good indicator of the liver’s function. The liver cleans bilirubin from the body by excreting it through the bile into the intestines. Elevated bilirubin levels can be indicative of liver disorders or blockage of bile ducts.

**Albumin**
The main protein in human blood (the primary component of total protein), albumin is made by the liver. Laboratory testing indicates how well the liver is making albumin. Liver disease results in decreased albumin production. Albumin normal range for 1 to 3 years old is 3.4-4.2 g/dl, and for age 4 to 7 is 3.2-5.2.

**Total protein**
The majority of plasma proteins (albumin and globulins) in the body are produced by the liver. Proteins are the most abundant compound serum. The protein makeup is significant because of protein’s involvement in enzymes, hormones, and antibodies as well as maintaining acid base balance and as reserve source of nutrition for the bodies tissues and muscles. Laboratory testing for total protein is a way to differentiate between normal and abnormal liver function. Total protein normal range is 6.0-8.3 gm/dl (grams per deciliter).

**Prothrombin Time**
The Prothrombin Time (PT) or Protime is a laboratory test used to evaluate normal or abnormal blood clotting. Blood clotting factors are proteins which are made by the liver. If the liver is injured or damaged, the clotting factors are not produced naturally. Prothrombin time normal range is 11 to 13.5 seconds.

**Acid/Alkaline Balance & Detox**
Restoring a proper pH balance will improve vitality and assist the detox process. An acidic condition robs the body of oxygen and can enable harmful pathogens to thrive. If you are too acidic, you will not assimilate nutrients efficiently from the foods you eat or the supplements you take. And the body will be forced to pull essential minerals like calcium, magnesium, potassium and sodium from your organs and bones to neutralize the acids.

**Foods that Improve Liver Function**
- Eat plenty of fresh fruits and lightly cooked vegetables, especially dark green leafy vegetables and orange, yellow, purple, and red colored fruits and vegetables- they contain living enzymes, fiber, vitamin C, natural antibiotics substances and phyto-nutrients.
- Eat foods that are rich in glutathione or help to produce glutathione in the body. Asparagus, watermelon, and broccoli are good sources of glutathione while papayas and avocados are foods that help the body produce glutathione. Glutathione is found within the chlorella growth factor (CGF) and is concentrated in the nuclei of the algae,
• Chlorella pyrenoidosa.
• Bitter foods like dandelion greens, mustard greens, bitter melon, Romaine lettuce and broccoli raabe can help in cleansing the liver.
• Herbs like dill, caraway seeds, garlic, onions, turmeric and cayenne are easy to use in cooking and can help protect the liver.
• Drink lots of filtered water (6-12 cups per day) because it helps the kidneys to get rid of the toxins that the liver has broken down.
• Omega-3 fats are very helpful. These fats are found in cold water fish such as salmon, mackerel, sardines, and halibut. Other good sources are flaxseeds, flaxseed oil and walnuts.
• Nuts, seeds, and avocados are good food sources of polyunsaturated fats and monounsaturated fats that are less harmful to the liver than saturated fats. Walnuts are a source of arginine which helps the liver to detoxify ammonia, a waste product in the body. They are also a rich source of glutathione and omega-3 fatty acids.

**Foods that Make the Liver Work Harder**

Saturated fats are harder for the liver to process. Limit high fat meats like sausage, bacon, salami, hot dogs, and high fat dairy products like whole milk, ice cream and cheese, which contain saturated fats. Other foods to limit that have a lot of saturated fat are french fries and high fat snack foods like potato chips, corn chips, etc. Limit processed foods like white bread, white rice, cakes, cookies, donuts and candy. Add whole grains like whole grain breads and cereal, brown rice and quinoa to your diet. Eat light meals more frequently. Eating a light evening meal can help to reduce the liver’s work during the healing hours of sleep. Limit, as much as possible, chemicals such as food colorings, flavorings and preservatives as well as toxins such as insecticides and pesticides because these substances make the liver work harder.

**The Importance of Eating Organic**

It is important to buy organically grown instead of the conventionally grown foods found in most grocery stores. Conventionally grown produce contains pesticides and other dangerous chemicals. It is usually grown in depleted soils, which may make it mineral deficient. Organic produce is grown without pesticides or harsh chemicals. This is especially important for children since what are considered "safe" pesticide levels for adults can be harmful to a child's small, developing body. Organic produce is usually grown in soil that has been replenished with organic materials rich in the full spectrum of minerals your child's body needs. There is a recent study reported in The Journal of Applied Nutrition that compared organic fruits and vegetables with conventional. It shows that organics are twice as rich in some nutrients. In addition, organic produce usually has more trace minerals and micronutrients than conventional. Buying organic insures a healthier planet for our kids since organic farming promotes sustainability of the land and is less polluting to the air and water than conventional farming. Organic produce also has more flavor. You can actually taste the difference!
What's All This Talk About Beta Glucans?

Beta 1-3 & 1-6 Glucan are considered a food for the liver and work by activating the macrophages (or immune cells), which trap and engulf foreign substances. These activated cells start a cascade of events that cause the entire system to be alerted and mobilized, in a naturally activated sequence. This amplified immune system response helps speed up the recovery of damaged tissue; helps other substances like antibiotics, antifungals, and antiparasitics, to work better, and helps the macrophages recognize and destroy mutated cells.

Your Child and the Environment

Children are our future, numbering over 2.3 billion worldwide (aged 0-19) and representing boundless potential. Child survival and development hinge on basic needs to support life; among these, a safe, healthy and clean environment is fundamental.

"Children are exposed to serious health risks from environmental hazards. Over 40% of the global burden of disease attributed to environmental factors falls on children below the age of five years of age, who account for only about 10% of the world's population. Environmental risk factors often act in concert, and their effects are exacerbated by adverse social and economic conditions, particularly conflict, poverty, and malnutrition. There is new knowledge about the special susceptibility of children to environmental risks: action needs to be taken to allow them to grow up and develop in good health, and to contribute to economic and social development."

-World Health Organization

Each year, at least 3 million children under the age of five die due to environment-related diseases.

Heavy or toxic metals are trace metals that are at least five times denser than water. They are stable elements in that they cannot be metabolized by the body, digested and removed as waste. They are also bioaccumulative; they are passed up the food chain to humans and all living creatures.

Maintaining a daily flow of removing toxins and acids while restoring alkaline reserve, vitamins and minerals and minimizing our toxic effects on the environment has become a priority we cannot ignore. Keep in mind when you buy clothing detergent, a new paint for the house, or let your car idle while someone 'ducks into the store for a moment', that "We all live downstream." The actions or non actions of yours and your family's life style effect every child now and for the next generations to come.
What Will I See When My Child's Liver is Functioning Well?

- better social skills
- increased communication
- appropriate speech
- more focus
- improved comprehension
- ability to do school work
- much more calm
- consistency in day to day abilities
- better absorption of nutrients from foods which enables them to decrease mega doses of vitamins and minerals
- decrease in food sensitivities
- better formed bowel movements

About BioRay™ Inc.

BioRay™ Inc. utilizes the extraordinary balance of nature and science to create whole food supplements that support health, vitality and our environment. BioRay™ products were created in clinic and are manufactured by integrating clinically tested ingredient technologies along with proprietary methods; maximizing product safety and efficacy. Committed to quality and maintaining the integrity of each formula, we blend our products in small, personally attended batches. To guarantee purity and potency, all of our products are analyzed by third party laboratories. BioRay™ Inc. is dedicated to making a fundamental difference within the autism community through education, research and product development.

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