frontiers | Frontiers for Young Minds

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WHEN "PEER PRESSURE" IS POSITIVE

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YOUNG REVIEWERS:

ALEX
AGE: 12

AMBER
AGE: 15

STEVEN
AGE: 16

Have you ever noticed that you are more likely to do something when your friends are doing it, too? Fitting in with friends is important during the teenage years, so being influenced by others is completely normal! Sometimes we can even be influenced to do good things, like helping others. There are many changes happening in teenagers' bodies that influence the way they interact with others (which is called social behavior). Changes include development of the "social brain", which allows teens to have deeper thoughts about themselves and others, and shifts in hormone levels. Looking at 136 teens aged 11–14 years, this study shows that teens can be influenced to make prosocial decisions—decisions that benefit others. Being influenced in this way is associated with particular hormonal changes, and with activation in regions of the "social brain". This research highlights the complex relationship between biology and the influence of our peers on our behavior.

PEERS, BRAIN DEVELOPMENT, AND HORMONES

Imagine you are working hard at school all day. You have spent your morning paying close attention to your teachers, reading, and maybe even finishing an assignment early. All the while, you are just waiting for the free period bell to go off. Finally, you are just about to take your break when your teacher asks if you would be willing to spend your free period writing letters to support a local charity. Would you do it? You know it is for a good cause, but you have been working so hard, you deserve a break! Would your answer change if you saw your friends staying behind to write letters, too?

Often, young people base their attitudes and behaviors off those of their friends and classmates. Fitting in with friends is important during the teen years (also known as adolescence). This desire to fit can encourage young people to conform to, or copy, their classmates and friends, so that they are more likely to be accepted and liked by others [1, 2]. While some view **peer conformity** as harmful, this "peer pressure" can also have positive influences on teens' behavior! Research shows that adolescents also conform to their peers' prosocial behaviors. **Prosocial behavior** describes actions that are meant to benefit others, such as volunteering, donating, and sharing. Therefore, prosocial conformity occurs when adolescents copy the prosocial behaviors of their peers. This means that young people can be influenced to engage in behaviors that help other people [3]!

PEER CONFORMITY

The choice to take on the behaviors and attitudes of others.

PROSOCIAL BEHAVIOR

Behaviors that are helpful to others or the community.

During adolescence, the brain goes through changes that make friends and other social information extra important. For example, certain areas of the **social brain**, such as the temporoparietal junction (TPJ) and posterior superior temporal sulcus (pSTS), are related to noticing and processing social information (like people's facial expressions and social rules) and motivating prosocial behavior.

SOCIAL BRAIN

Areas of the brain that are related to noticing and processing social information as well as motivating social behavior.

Along with the brain, hormones play a key role in social behavior. Hormones are chemicals in the body that send messages to coordinate various bodily functions. You may have learned about two well-known hormones called **cortisol** and **testosterone**. You might also have heard that cortisol is related to stress and testosterone is related to puberty. While these statements are true, both hormones do much more than that—they also work together and with the brain to influence behavior. For example, when testosterone is high, reward-sensitive brain regions are more active. Reward-sensitive brain regions are parts of the brain that focus on rewards in the environment, like getting compliments from friends or having fun while doing an activity. In social situations, this can increase a person's motivation to do things that will get other people to like them [4]. On the other hand, when cortisol is high, these same reward-sensitive brain regions become less active and may lead a person to avoid social situations.

CORTISOL

A hormone related to the body's stress response.

TESTOSTERONE

A hormone related to puberty and social status seeking behaviors.

DUAL HORMONE HYPOTHESIS

A theory that suggests that cortisol and testosterone work together to influence social behavior.

The observation that testosterone and cortisol can have *opposite* effects on social behavior led to a theory called the **dual hormone hypothesis**, which suggests that the effect of testosterone on behavior depends on how much cortisol someone has [5]. Most research on the dual hormone hypothesis focuses on how testosterone and cortisol are related to aggressive behaviors like fighting or spreading rumors about others. However, some researchers believe that the effect of these hormones on behavior depends on the social situation. So, if being helpful to others will probably get other people to like you more, then testosterone and cortisol may also play a role in influencing prosocial behavior!

This leaves us with two questions: (1) Do teens' decisions to conform to prosocial peers depend on their levels of cortisol and testosterone? (2) If so, which brain regions participate in prosocial conformity? We hypothesized that high testosterone and low cortisol might be associated with prosocial behavior and with greater activation in brain regions responsible for social behavior and reward processing.

HOW DID WE STUDY THIS?

We worked with 136 middle school students (69 females/67 males) between the ages of 11–14 years, from various racial and ethnic backgrounds (36% Latinx, 29% White, 22% Black, and 12% other). First, we cut off just a few strands of hair from the participants and sent the strands to a lab for analysis. Hair tells us about average hormone levels in the body, which is more stable than measuring hormone levels from saliva or blood. Then, Participants completed a three-round task while undergoing a brain scan called **functional magnetic resonance imaging (fMRI)**, which uses the magnetic properties of the blood to track changes in blood flow. Increased blood flow to a brain region means that area is activated or being used. In addition to the brain scan, participants' hormone levels were measured from hair samples.

FUNCTIONAL MAGNETIC RESONANCE IMAGING (fMRI)

Acronym for functional magnetic resonance imaging. Procedure that tracks blood flow in the brain to identify activation or use of particular brain regions.

PEER CONFEDERATE

A fake participant in a study that has the same age, sex, school, and grade as the actual participant.

Before Round 1 of the task, participants were told that the research team had partnered with 10 local charities. Participants were shown the logos, descriptions, and goals of each charity and were asked to rank their top-three favorite organizations. The participants were told that they could help the charities by filling envelopes with donation letters during their 10-min break after all three rounds of the task were completed. They were also told that another participant had completed the same task. This participant was a **peer confederate**, or a fake participant. We pretended the peer confederate was in the same school and grade and had the same age and gender as the real participant.

During Round 1, the participants saw one of their top 3 charities on the screen and independently chose how much of their break time they

wanted to donate to letter-filling for this charity. They could choose anywhere between 0 and 9 min.

Round 2 was the "peer-observation round". In this round, participants watched on a screen how much time the peer confederate donated to each charity. Then, the participant had to select the same amount of time. For example, if the peer confederate donated 5 min of break time, the participant would also enter 5 min. The participants were asked to complete this step because it ensured that they practiced copying the peer confederate. We wanted to see if the act of copying the peer confederate's behavior would lead to participants changing their own behavior in the following round. Half of the participants observed a highly prosocial confederate who donated an average of 8 min, while the other half observed a less prosocial confederate, who only donated an average of 2 min.

Finally, in Round 3, participants again independently chose how much of their break time to donate one of their top 3 charities. During their break at the end of the fMRI task, participants either took a 10-min break to play games or they filled envelopes. If they were filling envelopes, we randomly selected one of the participant's top three charities and participants filled envelopes for the amount of time that they had selected when shown that charity during the task. If they selected a time under 10 min, the participants were given the rest of the 10 min to play games. For example, if they selected 6 min to fill envelopes during the task, they got to spend the remaining 4 min playing games. See Figure 1 for an illustration of our study design.

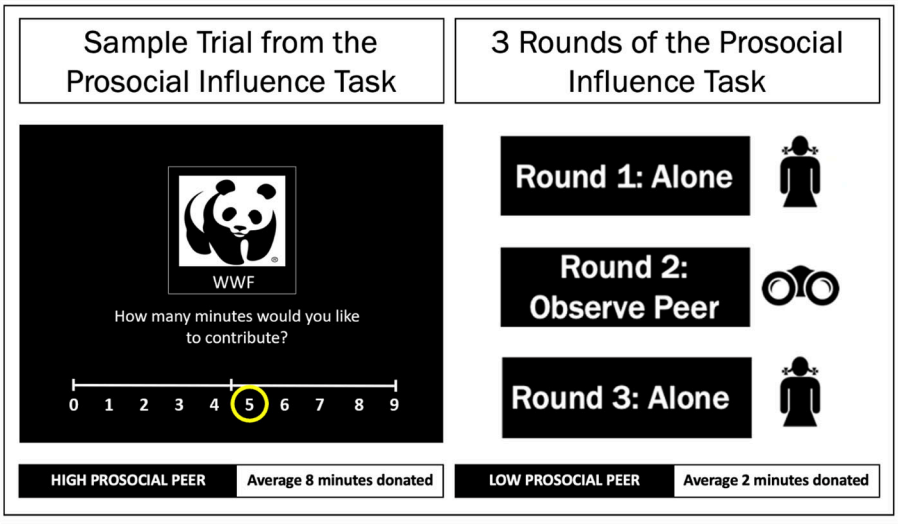

Figure 1

Figure 1

This figure shows the task that participants completed. In Round 1, participants saw a screen like the one on the left, and independently chose how many minutes they wanted to contribute to their one of their top three charities. In Round 2, participants were asked to view a peer confederate's choices and match the number of minutes chosen by the peer confederate. In Round 3, the participants again chose on their own how many minutes to donate. High prosocial confederates donated an average of 8 min while low prosocial confederates donated an average of 2 min.

PEERS AND HORMONES AFFECT PROSOCIAL BEHAVIOR AND BRAIN ACTIVITY

First, we wanted to know whether watching and copying the decisions of the peer confederate changed participants' behavior. Before they observed the peer confederate's behavior (in Round 1), all participants donated similar amounts of minutes to stuffing letters. After the peer observation round (Round 2), those who observed a high prosocial peer donated more minutes to charity in Round 3, and participants who observed a low prosocial peer donated fewer minutes to charity (see Figure 2). In other words, participants changed their behavior based on how many minutes the peer confederate donated.

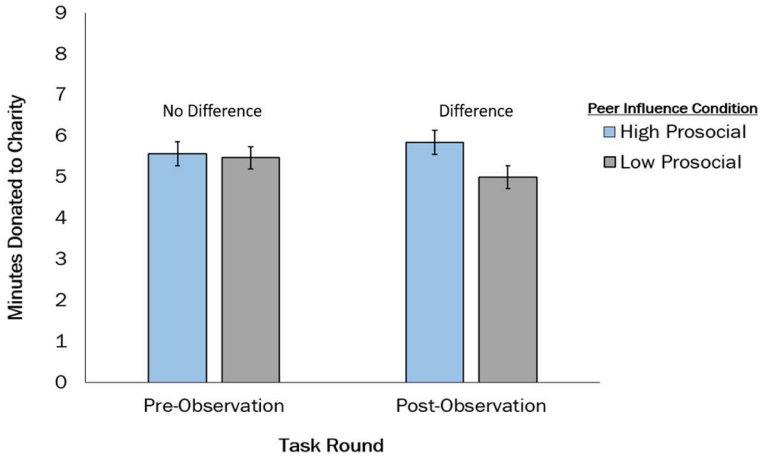

Figure 2

Figure 2

Teens changed their behavior depending on what their peers did. In Round 1 before the peer observation round, teens donated an equal number of minutes to charity. In Round 3, after the peer observation round, teens who observed a high prosocial peer (blue bars) donated more minutes to charity than they did in the pre-observation round, and teens who observed a low prosocial peer (gray bars) donated fewer minutes than they did in the pre-observation round.

The study also showed that adolescents' conformity to their peers' donation choices was related to their hormones. Participants with high testosterone and low cortisol levels were more likely to conform to a prosocial peer than were participants who had high testosterone and cortisol, low testosterone and cortisol, or low testosterone and high cortisol. This finding supports the dual hormone hypothesis because it shows that the effect of testosterone on social behavior depends on cortisol levels. These findings also teach us an important lesson: hormones do not work in isolation, but instead interact with each other to affect our behavior.

Data from the fMRI scans were analyzed to examine whether the interaction of cortisol and testosterone was associated with activation in certain brain regions when teens conformed to the prosocial peer confederates. Results showed that, for teenagers with high testosterone and low cortisol, activation in the posterior superior temporal sulcus (pSTS) and the temporoparietal junction (TPJ) was associated with greater conformity to prosocial peers. Both regions, as noted earlier, are believed to be important parts of the social brain. Increased activation was also seen in a brain region called the insula, which has been shown to be activated when people make

prosocial decisions, and in the orbitofrontal cortex (OFC) and caudate, which are associated with cooperation and learning from rewards, like answering a question correctly in class, getting a good grade on a test, or receiving praise from a teacher. See Figure 3 for pictures of these activated brain regions. These findings suggest that high testosterone and low cortisol may be associated with sensitivity to the social rewards, such as getting compliments from classmates or having fun with friends, that come with prosocial behavior.

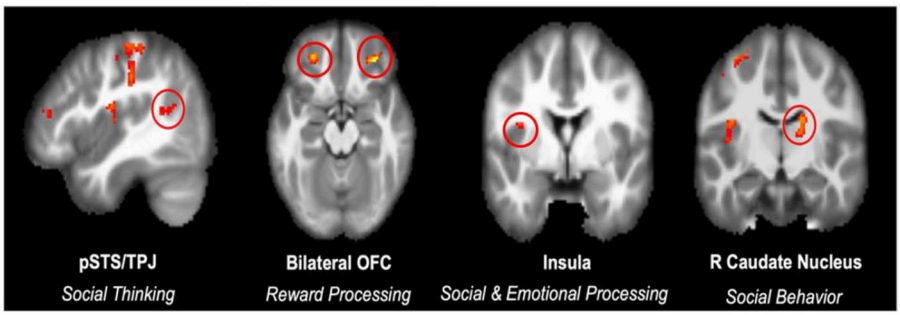

Figure 3

Figure 3

Certain brain regions activate when teenagers follow positive peer pressure. The circled regions are parts of the brain that are more active when participants who have high testosterone and low cortisol are following peer pressure to donate more time to charity. People with high testosterone and low cortisol show more activation in brain regions called the posterior superior temporal sulcus/temporoparietal junction (pSTS/TPJ), orbitofrontal cortex (OFC), insula, and caudate nucleus when they follow positive peer pressure. All of these regions are important for processing social information (such as another person's behavior) and rewards (such as the positive feeling of donating money to charity).

WHAT HAVE WE LEARNED ABOUT PEER CONFORMITY IN TEENS?

While we are often taught that peer conformity is a bad thing, findings from this research suggest that adapting to peer behavior can sometimes be a good thing. Similarly, high levels of testosterone are often considered to be a problem because of past research showing a relationship between testosterone and aggression. However, our study suggests that the effect of testosterone on social behavior also depends on context—whether peers are modeling prosocial or antisocial behavior—and individual differences in cortisol levels. High testosterone with low cortisol is associated with greater prosocial conformity. Therefore, the social context and biology work together to help us make decisions and interact with the world around us. This research also emphasizes the importance of surrounding yourself with prosocial peers. If you are around other people who are helpful to others and the community, you are more likely to be helpful yourself! So, if your teacher asks whether you would like to go outside during recess or help write letters for a charity, think about how your behavior may be affected by the decisions of others and how others may be affected by your choices!

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YOUNG REVIEWERS

ALEX, AGE: 12

I like to play baseball and tennis. I like to go fishing anywhere, especially in Florida. I also fly fish and like hiking and camping in the Rocky Mountains. Math and Science are my favorite subjects.

AMBER, AGE: 15

Hi! My name is Amber, from Hangzhou, China. I am 15 years old now. My greatest interest goes to reading books about psychology and nature. These books have opened multiple doors for my mind. I am also a music lover, especially lyrical songs. In my spare time, I love to bake with my family, as these are all romantic things

STEVEN, AGE: 16

Hi! My name is Steven, from Beijing, China. I am 16 year old now. I love reading, ranging from science to humanity. I am particularly into psychology, which explains how our mind and body work together from various perspectives. Plus, table tennis and musical shows are my favorites as well.

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Kennedy Kreidell is a first-year graduate student at Virginia Tech where she studies moral development and prosocial behavior. She received a B.A. in Psychology from the University of North Carolina at Chapel Hill, where she received Highest Honors Distinction for work on her independent research thesis. During her undergraduate career, Kennedy worked at UNC in the Developmental Social Neuroscience Lab as well as the Frank Porter Graham Child Development Institute, mostly focusing on adolescent peer relationships. She also worked at Boston College in the Social Learning Lab and Canine Cognition Center, studying social learning and bounded exploration in children and dogs. *kennedyjkreidell@gmail.com

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Natasha Duell is an assistant professor of psychology and child development at Cal Poly San Luis Obispo. She received her B.A. in psychology from UC Irvine and her Ph.D. in psychology from Temple University. Natasha was also an NSF postdoctoral fellow in the department of Psychology and Neuroscience at UNC Chapel Hill. Broadly, Natasha's research explores the psychological, social, and biological factors influencing young peoples' decisions. She is especially interested in how certain contexts can lead teenagers to make good decisions. A key theme in her research is focusing on individual strengths and highlighting experiences of people from diverse backgrounds. To answer her research questions, Natasha uses methods including experimental games, fMRI, daily surveys, and hormone samples.