Title: Re-thinking pest control strategies with novel ecological mechanism of chemical communication

When detecting organic compounds in the environment, animals can direct themselves toward resources, such as food, shelters, and mates, and even sense the presence of predators. Therefore, possessing sensitive and reliable chemical sensors (i.e., olfaction and taste) is primordial for the successful survival of many species. Insects are masters in detecting minute amounts of chemical compounds produced by other organisms and are very effective in locating a hidden source. By learning these mechanisms of chemical communication, we can design ecology-inspired methods to manipulate the distribution of insect populations that are relevant to our society.

Some insect species are detrimental to our health, agriculture and domestic establishments and resilient to chemical control methods due to rapid insurgence of insecticide resistance. Combined with extremely high costs of insecticide development and registration, alternative methods of control may provide innovative solutions while reducing our exposure to insecticides. Strategies that use repellents or attract-and-kill methods for pest insects can maximize the effect of insecticides and concentrate its activity range. For this purpose, we must first identify chemical compounds that trigger behavioral responses (semiochemicals) and develop ways to deploy them.

Much effort has been concentrated in identifying semiochemicals, like pheromones, from body parts under laboratory conditions. Although, these discoveries seem promising to the development of semiochemicals-based products, they may not deliver the expected impact under field conditions because environmental agents, like ozone and solar radiation, degrade semiochemicals *via* chemical reactions (e.g., ozonolysis and photolysis). However, since facing habitat conditions is unavoidable but insects successfully locate resources, insects may have evolved strategies to counteract or benefit from environmental agents.

Using various pest insects as models (e.g., cockroaches and flies), I am investigating the role of environmental factors as activating agents of semiochemicals. Cuticular hydrocarbons (CHCs) are waxes on the insect surface that prevents dehydration and infection. Because CHCs are large molecules and, thus, not volatiles, they are not involved in long-range attraction or repellency. However, my research shows that CHCs can be broken into small volatile fragments by reactive environmental agents and serve as semiochemicals to other individuals. Combining chemical analyses, electrophysiological techniques and behavioral assays, I identified these volatile semiochemicals, some of which were never described for these species. Very few reports studied this mechanism but they focused on single targeted compounds while my research shows that multiple compounds are simultaneously formed. We know from past studies that the composition of volatiles in a mix determines a behavioral response rather than individual components. Therefore, investigating all breakdown compounds as a mix is more relevant than investigating targeted compounds. In addition, the fact that new active compounds were found suggests that this phenomenon might offer a new pool of semiochemicals. Finally, innovations may not need to emit active attractants or repellents themselves but can be treated with their precursors that will be activated by environmental agents. Although the development of new insecticides is slow, we might re-evaluate our strategies to manage insect populations by taking advantage of their own ecology to better use current available products.