A. Overview	**A.1. Purpose**	**NetLogo model of USA mass shootings** is designed and developed to study mass shooting's characteristics considering factors such as the psychological state of a person (potential shooter) and the availability of weapons to humans. The main objects of the model are the humans and the guns. The main factors influencing behavior are the population size, the number of people with mental disabilities ("psycho" in the model terminology) per 100,000 population, the total number of weapons ("guns") in the population, the availability of guns for humans, the intensity of stressors affecting humans and the threshold level of stress, upon reaching which a person commits an act of mass shooting.
	A.2. Entities, state variables and scales	
	Agents/individuals	Agents in the model are humans and guns. Agents don't form any teams, groups or other types of collectives.
	Spatial units	Spatial units in the model are absent, in the sense that space (World) used to visualize the placement of objects (people (living and dead), guns and outbreaks of shots).
	Environment	In the model there are no affecting (external) forces that drive the behavior and dynamics of all agents.
	Collectives	Model agents are not combined into teams and collectives.
	A.3. Process overview and scheduling	The population dynamics are determined by the following factors: average (normally distributed) life expectancy ("life_span" attribute of humans) and population growth with the percentage of newborns set by the value of the **TickReprRatio%** slider of the current population volume from 16 to 45 years old. Thus, one step of model time corresponds to a year. The experiment begins with the creation of a population of adults with a randomly distributed value of age and position in space, as well as a population of guns (in the amount specified by the product of the value **GunHumanRatio** slider by the size of the population of people), also randomly distributed in space. In the process of a simulation experiment, people and guns make random movements in space. At each step of the experiment, a breed of stressors is born (in quantities equal to the product of the slider **StressorsHumanRatio** value by the current size of population), characterized by a random distribution of the force of influence ("value" attribute of stressors) and position in space. People experience the effects of stressors (the total simultaneous effect of stressors located from a person in the radius of **StressRadius**). At the end of one period of model time, the generation of stressors dies. If the threshold level of exposure is reached, the attribute "drive" of the human gets the value "true", which means a willingness to commit an act by a mass of shooting. The key difference between a normal person and a psycho is that a psycho accumulates (in memory of "memory_size" units, the

		value of "memory_size" is set in the model code) stressors and a normal person experiences only momentary stressors. A person who is ready to shoot with a probability of 1/3 performs an act of mass shooting now if there is a gun next to him (in radius **GunRadius**). After the shooting the shooter dies (both the victims and the shooter do not die as agents of the model, but get the "alive" attribute value "false" (and red color), so that during the experiment one can observe the shooting victims of past years). The number of psycho in a population is determined by the value of the **PsychoPer100000** slider, setting their number per 100,000 people. At each tick of the model time, a certain number of people is born, depending on the value of the **TickReprRatio%** slider and the size of the population from the age of 16 up to 45 years.
B. Design concept	B.1 Theoretical and Empirical background *Basic principles.*	The empirical basis for model development is the observed phenomenon: mass killings in the United States. There are various criteria for classifying a crime as a mass kill, which leads to different sets of statistics ((Follman, et al., 2020), (Silver, et al., 2018)). So, definition in the MOTHER JONES criteria is "indiscriminate rampages in public places with four or more people killed" and USA federal government's criteria is "three or more victims killed in an indiscriminate public rampage" (Follman, 2015). The question is debated about the extent to which such crimes are characteristic of the United States in comparison with other countries ((Lott Jr. & Mood, 2020) and (Lankford, 2019)). There are also various estimates of the number of weapons owned by civilians in the United States (Azrael, et al., 2017). When constructing the model, the author proceeded from two assumptions, which he considers to be sufficiently substantiated. Firstly, the availability of weapons for civilians is an influential factor (in Japan, weapons are available only to two categories of people - the police and gangsters. As a result, the number of all crimes with the use of weapons is minimal – less 50 times per one year from 2008 (Anon., 2018)). With zero weapons, there can be no mass shooting. And according to (Azrael, et al., 2017) 32% of US men said they personally owned a gun in 2015 and 12% US women said they personally owned a gun in 2015. Secondly, the psychological state of a potential shooter is an important contributing factor. Since not every one of us, at least once in a lifetime, picks up a weapon and shoots at others, we can assume either the individual's initial predisposition to aggression (of such a degree) or the influence on the individual of external factors motivating him to such an extraordinary act. These findings are supported by the results of FBI study of the Pre-Attack Behaviors of Active Shooters in the United States Between 2000 – 2013 (Silver, et al., 2018): only 25% of the

		active shooters were known to have been diagnosed by a mental health professional with a mental illness of any kind prior to the offense. The remaining 75% of shooters were (before firing) relatively normal people, at a certain stage of their life, exposed to strong stressors. But, what is significant, it was at that moment that they had at their disposal a very "strongly acting" means (weapons), which they used to express their dissatisfaction with the imperfect structure of the world. These are the basic principles on which this model is based.
	Emergence	With the default sliders, shooting is quite rare. An increase in the threshold level (**ShootingLevel**) leads to the fact that only psychos begin to commit acts of mass shooting. An increase in the radius of exposure to stressors **(StressRadius**), on the contrary, leads to the fact that a larger number of normal people reach a stress level sufficient to complete an act of mass shooting. A **FireRadius** value greater than 4 results in an unbelievably large number of casualties during mass shooting acts.
	B.2. Individual decision making (*Adaptation*)	
	Objectives	Objectives is quantities of mass shootings, victims (per one shooting act) and shooter's attributes: quantity psycho and not psycho humans among the shooters. They are measured quantitatively and are available to the survey in the model interface (plots, figures on World window and digitals in Observer window, see B.5. Observation section for details).
	Learning	The key difference (in the model) between a normal person and a psycho is that a psycho accumulates stressors and, upon reaching a threshold level, commits an act of mass shooting. A normal person is exposed to stressors, but reaching the threshold level for killing occurs only when the simultaneous effect of stressors on him exceeds this level.
	B.3. Individual prediction	Individuals (humans) do not predict future condition.
	B.4. Stochasticity	The number of "psycho" humans 100,000 people is a random value, which general mean is set by the slider **PsychoPer100000**. Human's ***life_span*** (agent's attribute) is random number with normal distribution. Initial human's and gun's coordinates in the World is random values. Humans make stochastic movements in the world, the speed of which is set by the value of the slider **Stoch_Motion_Speed**. If all the conditions for shooting are fulfilled, the shooter performs an mass shooting act at the given moment of model time with probability *1/3*.
	B.5. Observation	Reports: Killed humans (plot) is total number of victims (including shooters) during the experiment.

		Psycho humans (plot) is quantity of psycho-humans alive in population at the time. Humans / Humans with Guns (plot) are quantity of humans and humans in radius GunRadius from the gun at the time. Population Age Histogram (plot). For each mass shooting act: "Ticks, Shooter's age, victims, Psycho? (true/false)" (data in Observer window).
	B.6. Implementation Details	The model is coded in Netlogo 6.0.4, Open source and available on CoMSES (https://www.comses.net). NetLogo details. The world topology is a "torus". Lists are used by humans to memorize stressors values. Stressors are implemented as a breed since the introduction of humans links with each other (to simulate the interaction of humans creating stress) in case of the population size more than 1000 leads to a significant slowdown of the model running. If you mention this model or the NetLogo software in a publication, we ask that you include the citations below. For the model itself: Ivan, Smarzhevskiy (2019, September 24). "NetLogo model of USA mass shootings" (Version 1.0.0). *CoMSES Computational Model Library*. Retrieved from: https://www.comses.net/codebases/01a3a4f9-26ec-4a93-9d32-9e438a54cc7b/releases/1.0.0/ Please cite the NetLogo software as: * Wilensky, U. (1999). NetLogo. http://ccl.northwestern.edu/netlogo/. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.
C. Details	**C.1. Initialization**	Initialization is implemented by the setup procedure. Breeds of humans and guns are generated. For initialization model parameters are set by sliders **Quantity** and **GunHumanRatio**. Other sliders can be changed during model execution.
	C.2. Input data	The model does not use input data to represent time-varying processes.
	C.3. Submodels	
	Setup (procedure)	The procedure creates a specified number (**Quantity)** of humans and **Quantity** * **GunHumanRatio** guns. Set (at the time of model launch) Humans age as random 75 (years old). The main human's attributes are ***psycho*** (Bolean, *true* if human was born as psycho) ***age*** (current age) ***life_span*** (normal distributed number) ***hasgun*** (Boolean, *true* if a gun available for the human) ***alive*** (Bolean, *false* if human is killed in mass shooting act. Then human don't die as NetLogo agent and are visible in the World window during model run)

		drive (Boolean, *true* if the human has enough stress to do a mass shooting act) ***stress_list*** [] (stressor's storage) ***memory_size*** (volume of stressor's storage; by default equal to *3*). Create service breed "shots" for shot's flashes visualization. In the current version of the model, the population of guns does not increase and the weapons do not "die". A more realistic approach involves the implementation in the model of weapon life cycle and the increase in the number of units of guns over time (according to one or another rule).
	GunHumanRatio (slider)	The number of guns per one human (from 0 to 1)
	StressorsHumanRatio (slider)	The number of stressors, generated on one tick of model time, per one human (from 0 to 1).
	TickReprRatio% (slider)	The annual reproductive rate of a population is the percentage of newborns of the size of a population aged 16 to 45 years.
	StressorsVisible (On/Off)	Switch (on/off) of stressor's visibility in the World window.
	ShootingLevel (slider)	Stress level at which a person is ready to perform a mass shooting act.
	GunRadius (slider)	Guns reachability radius for humans.
	FireRadius (slider)	Victims reachability radius for shooter.
	StressRadius (slider)	Humans reachability radius for stressors.
	Stoch_Motion_Speed (slider)	It is possible to add a randomness factor to the movement of humans (**Stoch_Motion_Speed**, the default is set to 0, that is, there are no random movements).
	Go (procedure)	Implements the simulation process and control end of experiment execution. For each time moment (tick) of model running procedure • Implements a stochastic movement of persons and guns. • Generates stressors breed (quantity equal to **StressorsHumanRatio** * **Quantity**) and place sterssorss randomly in the World. The stressor's attribute is ***Value*** (a quantitative measure of the strength of a single stressor. Random variable uniformly distributed from 0 to 999.) • Call procedures **HasGun?**, **HasDrive?**, **Fire!!!**, **Generation** • Increases the age of humans by 1 year (set ***age*** value ***age*** + *1*) • Controls the death of humans with value ***age*** greater than ***life_span*** • Controls the death of current generation of stressors • Monitors the condition *ticks = 10000 or count humans with [alive] = 0* and, if its value equal to *true* stop model running.

	HasGun? (procedure)	The procedure sets the attribute ***hasgun*** value *true* for all humans near which (in radius **GunRadius**) there is a gun. Else sets the attribute ***hasgun*** value *false.*
	HasDrive? (procedure)	The procedure for all humans calculates sum ***value***s of stressors, being in radius **StressRadius** from the human. For psycho humans procedure calculate sum of stressors values, remembered in the list ***stress_list*** (previous effects of stressors) and if the result more then **ShootingLevel** sets the attribute ***drive*** value *true.* For humans with ***psycho*** attribute equal to *false* procedure check value of last stressors influence and if it is more then **ShootingLevel** sets the attribute ***drive*** value *true.*
	Fire!!! (procedure)	Procedure implements the mass shooting act. A person who is ready to shoot (attribute ***drive*** is equal to *true*, attribute ***hasgun*** is equal to *true* and he's over 11 years old), with a probability of *1/3* performs an act of mass shooting. As result of shooting • all humans in-radius **FireRadius** of shooter will die (not in NetLogo sense, but their ***alive*** attribute will be set to *false*); • after the shooting the shooter die (not in NetLogo sense, but his ***alive*** attribute will be set to *false*); • proceduree show in World window red bodies of humans with ***alive*** = *false* and to ten yellow stars (flashes by quantity of shots). Text *"Boo-bookh!!!"* and *Ticks, Shooter's age, victims quantity, Psycho? (yes/no)* will be displayed in the Observer window.
	Generation (procedure)	Procedure implements the population dynamics. The dynamics are determined by the following factors: average life expectancy ("life_span" attribute of humans) and population growth with the percentage of newborns set by the value of the **TickReprRatio%** slider of the current population volume (*v*) from 16 to 45 years old. Life span is normally distributed number with mean equal 75 and standard-deviation equal 6. Quantity of newborns is normally distributed number with mean equal *v * TickReprRatio% / 100* and standard-deviation equal *v / 20*. With **TickReprRatio%** less than 2.8, the population dies.
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