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Emergence of good conduct, scaling and Zipf laws in human behavioral sequences in an online world

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We study behavioral action sequences of players in a massive multiplayer online game. In their virtual life players use eight basic actions which allow them to interact with each other. These actions are communication, trade, establishing or breaking friendships and enmities, attack, and punishment. We measure the probabilities for these actions conditional on previous taken and received actions and find a dramatic increase of negative behavior immediately after receiving negative actions. Similarly, positive behavior is intensified by receiving positive actions. We observe a tendency towards anti-persistence in communication sequences. Classifying actions as positive (good) and negative (bad) allows us to define binary 'world lines' of lives of individuals. Positive and negative actions are persistent and occur in clusters, indicated by large scaling exponents alpha~0.87 of the mean square displacement of the world lines. For all eight action types we find strong signs for high levels of repetitiveness, especially for negative actions. We partition behavioral sequences into segments of length n (behavioral `words' and 'motifs') and study their statistical properties. We find two approximate power laws in the word ranking distribution, one with an exponent of kappa-1 for the ranks up to 100, and another with a lower exponent for higher ranks. The Shannon n-tuple redundancy yields large values and increases in terms of word length, further underscoring the non-trivial statistical properties of behavioral sequences. On the collective, societal level the timeseries of particular actions per day can be understood by a simple mean-reverting log-normal model.

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