Data Descriptor

A Model to Predict Children’s Reaction Time at Signalized Intersections

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Abstract: Traffic accident statistics in urban areas, both locally in Croatia and at the European level, identify children as a group of vulnerable road users. The analysis of the parameters that influence the interaction of child pedestrians and other road users requires special attention. This paper presents the results of research about the reaction time of children, measured both in laboratory conditions, via a computer reaction time test, and in actual traffic conditions. The results of the reaction time in the situation of expected stimuli (computer test) of children aged 6 to 10 years were compared with the results of the reaction time of adult traffic participants, drivers, who also took part in the computer test. In actual traffic conditions, the reaction time of children aged 4 to 16 years at the signalized intersection was measured. The model for predicting the reaction time of children in real traffic conditions was created using a neural network. Parameters influencing children’s reaction time in real traffic conditions have been identified by applying both statistical analysis and the developed neural network model. The case study was conducted at selected signalized intersections in the city of Osijek, Croatia.

Keywords: children in traffic; signalized intersections; reaction time; prediction model; neural networks

1. Summary

In this research the reaction time of children was measured under controlled conditions using computer software and in actual traffic conditions at a signalized intersection. The aim of this research is to increase the safety of specific segments of urban traffic network in close vicinity of schools and kindergartens. The case study was made for a selected intersection with traffic lights in the city of Osijek.

The methodology followed to develop the whole research is based on two steps: first of all, a laboratory experiment was carried out with a computer test, where both a target (children) and a control (adult) group had to react to an external displayed stimulus; the second step is the measure the reaction time of the same participants in real traffic conditions.

The first step allowed to identify some parameters influencing the reaction time under controlled conditions, and put the basis for the analysis and selection of the most influential parameters to be set as inputs for the neural network model.

Data collection under laboratory conditions was made within the framework of the project of the Croatian Science Foundation Problems in the Behavior of School-aged Children: The Role of Executive Functions, Individual, Family and Genetic Factors-ECLAT, project leader Asoc.prof. Silvije Ručević, HRZZ-IP-2016-06-3917. This research did not engage other project resources except for the availability of the target group for the research.

In the working phase of data collection, an article with descriptive statistics was published:
Ištoka Otković, Irena; Ručević, Silvija; Borovac, Tijana; Marschhauser, Max; Jeremič, Kristina. Analysis of the results of traffic participants’ time of reaction research for prevention of
2. Methods

The methodology followed to develop the whole research is based on two steps: first of all, a laboratory experiment was carried out with a computer test, where both a target (children) and a control (adult) group had to react to an external displayed stimulus; the second step is the measure the reaction time of the same participants in real traffic conditions.

The target group consists of kindergarten and elementary school children, and the control group consists of drivers from the city of Osijek. The database contains measurement results of 448 target group respondents (four groups of 112 measurements each) and 112 control group examinees. The reaction time was measured in controlled conditions, using Human benchmark Reaction time test (http://www.humanbenchmark.com/tests/reactiontime) (computer on-line test) on all participants, and additional data were gathered through a survey filled in both by the target and the control group.

The target group was divided into four subgroups—preschoolers (children from 6 to 7 years old), first class (children from 7 to 8 years old), second class (children from 8 to 9 years old) and third class (children from 9 to 10 years old) children. In this phase of the research, the working hypothesis was that the reaction times of each target group was longer than the reaction times of the control group, even in the conditions of expected stimuli. To each respondent it was explained what would be measured, how they should respond (press the mouse button when a red color appears on the screen), and each of them had the opportunity to try the test first, without recording the results. The reaction time was measured in milliseconds and the mean reaction time of 5 consecutive measurements for each respondent was registered.

Regarding ethical questions of research involving children, individual permissions for interviewing and measuring different indicators of executive behavior of each child were sign by the parents and only those children whose parents signed the consent were examined. Figure 1 is the approval of the Ethics Committee of the Josip Juraj Strossmayer University of Osijek, Faculty of Humanities and Social Sciences, to collect data and measure different indicators of children’s executive behavior (reference number: 1/4/2017i).
Mišljenje Etičkog povjerenstva Odsjeka za psihologiju za provedbu 3. točke istraživanja u sklopu projekta financiranog od strane Hrvatske Zdravstvene znanosti (HRZZ-IP-2016-66-3017) i Sveučilište J. J. Strossmayera (IZJP-2016-79)

Naslov projekta: Problemi u ponašanju djece školske dobi: Uloga izvršnih funkcija, individualnih, obiteljskih i genetskih čimbenika (referentni broj: 1/4/2017)
Voditelj projekta: izv. prof. dr. sc. Silvija Ručević
Trajanje projektnoga prijedloga (u mjesecima): 48 mjeseci
Datum izdavanja: 11.04.2017.

Mišljenje: Etičko povjerenstvo, nakon pregledanog nacerta i plana istraživanja, u kojemu su detaljno opisani upitnici, način njihove primjene te etička pitanja istraživanja smatra da je provedba istraživanja s etičke točke gleda prihvatljiva. Stoga se provedba gore navedenog istraživanja ODOBRAVA.

Napomene:
- Ovo odobrenje ne zamjenjuje odobrenja koja zahtijevaju druge osobe/ustanove/institucije/odjeli/odsjeci itd.
- Ovo odobrenje se izdaje na dvije godine. Nakon toga istraživač mora ponovno podnijeti zamolbu Etičkom povjerenstvu Odsjeka za psihologiju ili nekom drugom Etičkom povjerenstvu

Zamjenica predsjednika Etičkog povjerenstva Odsjeka za psihologiju

Doc. dr. sc. Ana Kurtović

Figure 1. Approval of the Ethics Committee.

The primary objective of the second phase of research, the in-situ research, was to collect data about the behavior and reaction time of children in actual traffic conditions, when children are influenced by the usual distractors in a familiar environment. A database of measured reaction time of children aged 5 to 16 years at a selected signalized intersection set on urban arterial road was created. The observed intersection is located near two primary schools and kindergarten. The
signalized intersection is traditionally considered as a pedestrian-friendly traffic solution because it does not require a detailed assessment of the traffic situation and was selected for the first phase of the study of traffic behavior of children. No license was required for video recording of traffic without personally identifying traffic users.

3. Data Description

3.1. Database 1

A database of measurement results of the reaction time of the target group (child pedestrians) and a control group (adult drivers) under controlled conditions was created.

Table 1 shows the reaction time measured by a computer test, as described in the previous section.

| Control Group | Preschoolers | First Class | Second Class | Third Class |
|---------------|--------------|-------------|--------------|-------------|
| 240           | 352          | 298         | 250          | 244         |
| 244           | 376          | 299         | 256          | 248         |
| 250           | 390          | 302         | 264          | 252         |
| 250           | 410          | 305         | 276          | 260         |
| 251           | 415          | 312         | 280          | 268         |
| 252           | 420          | 318         | 296          | 270         |
| 253           | 425          | 326         | 300          | 282         |
| 254           | 430          | 334         | 304          | 288         |
| 255           | 440          | 350         | 309          | 292         |
| 256           | 452          | 355         | 312          | 294         |
| 258           | 460          | 358         | 318          | 296         |
| 260           | 482          | 360         | 320          | 298         |
| 262           | 490          | 362         | 320          | 300         |
| 263           | 496          | 375         | 321          | 300         |
| 264           | 502          | 382         | 324          | 304         |
| 264           | 506          | 390         | 325          | 306         |
| 265           | 510          | 401         | 328          | 308         |
| 266           | 512          | 405         | 331          | 310         |
| 266           | 517          | 406         | 332          | 312         |
| 267           | 519          | 407         | 333          | 314         |
| 270           | 520          | 408         | 335          | 315         |
| 272           | 525          | 410         | 336          | 316         |
| 273           | 530          | 412         | 340          | 318         |
| 275           | 533          | 415         | 342          | 320         |
| 277           | 535          | 416         | 344          | 322         |
| 279           | 542          | 418         | 346          | 325         |
| 279           | 550          | 420         | 347          | 328         |
| 281           | 551          | 422         | 348          | 330         |
| 283           | 553          | 424         | 370          | 334         |
| 284           | 556          | 425         | 372          | 336         |
|   |   |   |   |   |
|---|---|---|---|---|
| 285 | 561 | 427 | 374 | 340 |
| 285 | 562 | 432 | 375 | 346 |
| 286 | 563 | 438 | 376 | 349 |
| 286 | 565 | 442 | 377 | 350 |
| 287 | 568 | 443 | 380 | 352 |
| 288 | 570 | 444 | 381 | 353 |
| 289 | 576 | 445 | 382 | 354 |
| 290 | 584 | 450 | 383 | 356 |
| 291 | 592 | 452 | 384 | 360 |
| 292 | 598 | 454 | 385 | 365 |
| 292 | 602 | 455 | 388 | 368 |
| 294 | 604 | 458 | 389 | 370 |
| 295 | 606 | 459 | 390 | 372 |
| 295 | 608 | 460 | 395 | 374 |
| 296 | 609 | 462 | 398 | 375 |
| 296 | 609 | 463 | 400 | 376 |
| 297 | 610 | 464 | 402 | 377 |
| 297 | 610 | 465 | 402 | 378 |
| 299 | 610 | 466 | 403 | 380 |
| 299 | 610 | 467 | 404 | 380 |
| 299 | 611 | 468 | 405 | 380 |
| 300 | 612 | 468 | 405 | 382 |
| 300 | 612 | 469 | 406 | 382 |
| 303 | 613 | 470 | 406 | 383 |
| 304 | 614 | 470 | 407 | 384 |
| 304 | 615 | 471 | 408 | 384 |
| 305 | 616 | 472 | 408 | 385 |
| 306 | 616 | 473 | 409 | 386 |
| 306 | 618 | 474 | 409 | 386 |
| 307 | 620 | 476 | 410 | 387 |
| 308 | 620 | 480 | 410 | 388 |
| 310 | 620 | 482 | 410 | 388 |
| 312 | 621 | 491 | 412 | 389 |
| 313 | 622 | 494 | 412 | 389 |
| 314 | 624 | 498 | 414 | 390 |
| 314 | 629 | 502 | 415 | 390 |
| 315 | 633 | 504 | 420 | 392 |
| 316 | 641 | 506 | 425 | 394 |
| 316 | 645 | 508 | 428 | 395 |
| 316 | 650 | 510 | 430 | 396 |
| 318 | 652 | 510 | 440 | 401 |
| 319 | 654 | 512 | 442 | 405 |
| 319 | 660 | 512 | 445 | 406 |
3.2. Database2

Based on previous experience and technical judgement of the situation, seven independent variables affecting the reaction time of children in traffic were selected:

- age group
• gender
• children with special needs (motoric disabilities, low vision and blindness, wheelchair mobility, etc.)
• movement in a group—the number of children in a group
• supervision by adults
• mobile–text– messages/internet
• mobile–talk, listening music

The age group input parameter was formed in such a way that each respondent with a measured reaction time was classified into one of the seven categories, as follows:
1→≤5 years old children; 2→6 to 7 years; 3→8 to 9 years; 4→10 to 11 years; 5→12 to 13 years; 6→14 to 15 years; 7→>15—over 15 years old).

Other parameters
• gender [girl →0, boys →1, for mixed groups (number of boys/total number of children)]
• children with special needs (motoric disabilities, low vision and blindness, wheelchair mobility, etc.) [no→0, minor interference→0,5, yes→1]
• movement in a group—the number of children in a group [number]—the whole group has the same crossing time and it is one data in a database, and the crossing time is the total transition time from the first to the last member of the group
• supervision by adults [no→0; yes→1]
• mobile–messages/internet—occupies visual attention [no→0; yes→1]
• mobile–talk, listening music—does not occupy visual attention [no→0; yes→1]
• dependent variable—reaction time measured in situ

Table 2 shows the database measured in actual traffic conditions.

| Age | Gender | Dissbil. | moving independ/in a group | Supervis. | MOB TXT | MOB SPEAK | Time of Reaction |
|-----|--------|----------|---------------------------|-----------|---------|-----------|-----------------|
| 5   | 0      | 0        | 2                         | 0         | 0       | 0         | 2               |
| 7   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 6   | 0      | 0        | 3                         | 0         | 0       | 0         | 4               |
| 6   | 1      | 0        | 2                         | 0         | 0       | 0         | 3               |
| 7   | 1      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 6   | 0      | 0        | 1                         | 0         | 1       | 0         | 4               |
| 5   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 6   | 1      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 5   | 0.5    | 0        | 2                         | 0         | 0       | 0         | 3.5             |
| 5   | 1      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 7   | 1      | 1        | 1                         | 0         | 0       | 0         | 5               |
| 6   | 0      | 0        | 1                         | 0         | 0       | 1         | 1.5             |
| 6   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 6   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               |
| 5   | 1      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 5   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 5   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               |
| 5   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             |
| 5   | 1      | 0        | 2                         | 0         | 0       | 0         | 2               |
|   | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|
| 6 | 6 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 4 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 3.5 |
| 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 4 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 4 |
| 4 | 0.33 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 4 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 |
| 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1.5 |
| 5 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 3 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2.5 |
| 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 5 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 4 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2.5 |
| 4 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 3 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 5 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 3 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 6 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 |
| 6 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1.5 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 7 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2.5 |
| 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1.5 |
| 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 7 | 0.5 | 0 | 2 | 0 | 0 | 0 | 0 | 2.5 |
| 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 7 | 0 | 0 | 1 | 0 | 1 | 0 | 4.5 |   |
| 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1.5 |
| 5 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1  |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 3  |
| 6 | 0 | 0 | 1 | 0 | 0 | 1 | 1.5 |   |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 7 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2  |
| 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2  |
| 6 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2  |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2  |
| 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 7 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1  |
| 5 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1  |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1  |
| 5 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1  |
| 6 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1.5 |
| 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2  |
| 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2  |
| 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1  |
| 5 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 3.5 |
| 5 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 3  |
| 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2  |
| 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 6 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2.5 |
| 5 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 1 | 0 | 5 | 0 | 0 | 0 | 0 | 4.5 |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 4 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2  |
| 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
| 5 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 3.5 |
| 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 3  |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 |
|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
|   |   |   |   |   |   |   |   |   |
|   | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 2 |
|   | 6 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
|   | 6 | 0 | 0 | 2 | 0 | 1 | 0 | 5.5 |
|   | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 7 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
|   | 6 | 0 | 0 | 1 | 0 | 0 | 1 | 2.5 |
|   | 6 | 0 | 0 | 1 | 0 | 1 | 0 | 5 |
|   | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 3 | 1 | 0 | 2 | 0 | 0 | 0 | 3.5 |
|   | 5 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 5 | 0.33 | 0 | 3 | 0 | 0 | 0 | 3 |
|   | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 1.5 |
|   | 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 3 | 1 | 0 | 3 | 0 | 0 | 0 | 4.5 |
|   | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 7 | 1 | 0 | 3 | 0 | 0 | 0 | 2.5 |
|   | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 6 | 0 | 0 | 1 | 0 | 1 | 0 | 6 |
|   | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1.5 |
|   | 6 | 0 | 0 | 2 | 0 | 1 | 0 | 6.5 |
|   | 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 5 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
|   | 5 | 1 | 0 | 1 | 0 | 0 | 0 | 0.5 |
|   | 6 | 1 | 0 | 1 | 0 | 0 | 1 | 1.5 |
|   | 4 | 0.5 | 0 | 6 | 0 | 0 | 0 | 5 |
|   | 4 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
|   | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 2.5 |
|   | 4 | 0.5 | 0 | 4 | 0 | 0 | 0 | 4 |
The database of 192 measured reaction times in actual traffic conditions was used to define and train the neural network.
3.2.1. Result of Neural Network Predictions

Table 3 shows the results of neural network prediction.

| Actual (1) | Network (1) | Act-Net (1) |
|------------|-------------|-------------|
| 1          | 2           | 1.912821174 | 0.087178826 |
| 2          | 0.5         | 0.555350661 | -0.055350661 |
| 3          | 4           | 3.066304684 | 0.933695316 |
| 4          | 3           | 1.977504253 | 1.022495747 |
| 5          | 0.5         | 0.721236289 | -0.221236289 |
| 6          | 4           | 4.779056549 | -0.779056549 |
| 7          | 0.5         | 0.788813651 | -0.288813651 |
| 8          | 0.5         | 0.847270966 | -0.347270966 |
| 9          | 3.5         | 2.058722734 | 1.441277266 |
| 10         | 0.5         | 1.012782931 | -0.512782931 |
| 11         | 5           | 4.90843153  | 0.09156847  |
| 12         | 1.5         | 1.963680625 | -0.463680625 |
| 13         | 0.5         | 0.655910194 | -0.155910194 |
| 14         | 1           | 0.847270966 | 0.152729034 |
| 15         | 1           | 1.012782931 | -0.012782931 |
| 16         | 1           | 0.847270966 | 0.152729034 |
| 17         | 0.5         | 1.012782931 | -0.512782931 |
| 18         | 0.5         | 0.788813651 | -0.288813651 |
| 19         | 1           | 1.012782931 | -0.012782931 |
| 20         | 0.5         | 0.788813651 | -0.288813651 |
| 21         | 2           | 2.194428921 | -0.194428921 |
| 22         | 1           | 0.655910194 | 0.344089806 |
| 23         | 1           | 0.847270966 | 0.152729034 |
| 24         | 0.5         | 0.788813651 | -0.288813651 |
| 25         | 0.5         | 0.788813651 | -0.288813651 |
| 26         | 0.5         | 1.012782931 | -0.512782931 |
| 27         | 3.5         | 2.127940416 | 1.372059584 |
| 28         | 1           | 1.170168281 | -0.170168281 |
| 29         | 1           | 1.223336697 | -0.223336697 |
| 30         | 4           | 3.584757566 | 0.415242434 |
| 31         | 3           | 3.433954    | -0.433954    |
| 32         | 1           | 1.223336697 | -0.223336697 |
| 33         | 3           | 2.452126265 | 0.547873735 |
| 34         | 1           | 1.170168281 | -0.170168281 |
| 35         | 0.5         | 0.788813651 | -0.288813651 |
| 36         | 1           | 1.170168281 | -0.170168281 |
| 37         | 1           | 0.655910194 | 0.344089806 |
| 38         | 1           | 1.223336697 | -0.223336697 |
| 39         | 1           | 0.958806157 | 0.041193843 |
| 40         | 3           | 2.376458406 | 0.623541594 |
| 41         | 1           | 1.483470917 | -0.483470917 |
| 42         | 1           | 1.483470917 | -0.483470917 |
|   | 1.5 | 1.242611766 | 0.257388234 |
|---|-----|-------------|-------------|
| 44 | 2   | 1.912821174 | 0.087178826 |
| 45 | 2.5 | 2.748173475 | -0.248173475|
| 46 | 1   | 0.847270966 | 0.152729034 |
| 47 | 4   | 5.126285553 | -1.126285553|
| 48 | 2.5 | 2.127940416 | 0.372059584 |
| 49 | 3   | 2.452126265 | 0.547837375 |
| 50 | 3   | 2.187721729 | 0.812278271 |
| 51 | 1   | 1.223336697 | -0.223336697|
| 52 | 2   | 2.187721729 | -0.187721729|
| 53 | 1   | 1.012782931 | -0.012782931|
| 54 | 0.5 | 0.847270966 | -0.347270966|
| 55 | 6   | 5.796794891 | 0.203205109 |
| 56 | 0.5 | 0.788813651 | -0.288813651|
| 57 | 0.5 | 0.788813651 | -0.288813651|
| 58 | 2.5 | 1.963680625 | 0.536319375 |
| 59 | 1   | 0.958806157 | 0.041193843 |
| 60 | 2.5 | 1.801196694 | 0.698803306 |
| 61 | 1.5 | 1.483470917 | 0.016529083 |
| 62 | 0.5 | 0.847270966 | -0.347270966|
| 63 | 2.5 | 1.689571142 | 0.810428858 |
| 64 | 3   | 2.376458406 | 0.623541594 |
| 65 | 1   | 1.170168281 | -0.170168281|
| 66 | 2   | 2.429891348 | -0.429891348|
| 67 | 1   | 1.483470917 | -0.483470917|
| 68 | 4.5 | 4.56542635  | -0.06542635 |
| 69 | 1.5 | 1.242611766 | 0.257388234 |
| 70 | 1   | 1.012782931 | -0.012782931|
| 71 | 0.5 | 0.788813651 | -0.288813651|
| 72 | 0.5 | 0.655910194 | -0.155910194|
| 73 | 3   | 3.397898197 | -0.397898197|
| 74 | 1.5 | 1.963680625 | -0.463680625|
| 75 | 0.5 | 0.788813651 | -0.288813651|
| 76 | 0.5 | 0.847270966 | -0.347270966|
| 77 | 2   | 1.801196694 | 0.198803306 |
| 78 | 0.5 | 0.555350661 | -0.055350661|
| 79 | 2   | 1.731890082 | 0.268109918 |
| 80 | 2   | 1.963680625 | 0.036319375 |
| 81 | 0.5 | 0.788813651 | -0.288813651|
| 82 | 0.5 | 0.555350661 | -0.055350661|
| 83 | 2   | 1.731890082 | 0.268109918 |
| 84 | 0.5 | 0.655910194 | -0.155910194|
| 85 | 1   | 0.721236289 | 0.278763711 |
| 86 | 1   | 1.012782931 | -0.012782931|
| 87 | 0.5 | 0.788813651 | -0.288813651|
| 88 | 1   | 0.788813651 | 0.211186349 |
| 89 | 1   | 1.012782931 | -0.012782931|
|   |   |   |   |
|---|---|---|---|
| 90 | 1.5 | 1.679797769 | −0.179797769 |
| 91 | 2  | 1.731890082 | 0.268109918  |
| 92 | 2  | 1.425770879 | 0.574229121  |
| 93 | 1  | 0.847270966 | 0.152729034  |
| 94 | 3.5 | 4.061533928 | −0.561533928 |
| 95 | 3  | 2.194428921 | 0.805571079  |
| 96 | 2  | 1.731890082 | 0.268109918  |
| 97 | 0.5 | 0.655910194 | −0.15910194  |
| 98 | 2.5 | 3.066304684 | −0.566304684 |
| 99 | 0.5 | 1.012782931 | −0.512782931 |
| 100 | 0.5 | 0.788813651 | −0.288813651 |
| 101 | 4.5 | 4.547066689 | −0.047066689 |
| 102 | 0.5 | 0.958806157 | −0.458806157 |
| 103 | 2  | 2.452126265 | −0.452126265 |
| 104 | 0.5 | 0.655910194 | −0.15910194  |
| 105 | 3.5 | 4.175287247 | −0.675287247 |
| 106 | 3  | 1.795311809 | 1.204688191  |
| 107 | 0.5 | 0.958806157 | −0.458806157 |
| 108 | 2  | 2.040986061 | −0.040986061 |
| 109 | 2  | 1.963680625 | 0.036319375  |
| 110 | 5.5 | 6.566308975 | −1.066308975 |
| 111 | 1  | 0.721236289 | 0.278763711  |
| 112 | 0.5 | 0.721236289 | −0.221236289 |
| 113 | 0.5 | 0.655910194 | −0.15910194  |
| 114 | 2  | 1.58428812 | 0.41571188   |
| 115 | 2.5 | 1.963680625 | 0.536319375  |
| 116 | 5  | 4.779056549 | 0.220943451  |
| 117 | 1  | 0.721236289 | 0.278763711  |
| 118 | 1  | 0.847270966 | 0.152729034  |
| 119 | 3.5 | 2.748173475 | 0.751826525  |
| 120 | 1  | 1.012782931 | −0.012782931 |
| 121 | 0.5 | 0.721236289 | −0.221236289 |
| 122 | 3  | 3.273521662 | −0.723521662 |
| 123 | 0.5 | 0.847270966 | −0.347270966 |
| 124 | 1  | 1.223336697 | −0.223336697 |
| 125 | 0.5 | 0.847270966 | −0.347270966 |
| 126 | 0.5 | 0.655910194 | −0.15910194  |
| 127 | 1  | 1.483470917 | −0.483470917 |
| 128 | 0.5 | 0.555350661 | −0.055350661 |
| 129 | 1.5 | 1.425770879 | 0.074229121  |
| 130 | 0.5 | 0.555350661 | −0.055350661 |
| 131 | 4.5 | 3.79486084 | 0.70513916   |
| 132 | 1  | 1.483470917 | −0.483470917 |
| 133 | 2.5 | 3.105931282 | −0.605931282 |
| 134 | 0.5 | 0.721236289 | −0.221236289 |
| 135 | 0.5 | 0.655910194 | −0.15910194  |
| 136 | 6  | 4.779056549 | 1.220943451  |
|   |   |   |   |
|---|---|---|---|
| 137| 1.5| 1.795311809| -0.295311809|
| 138| 6.5| 6.566308975| -0.066308975|
| 139| 0.5| 0.555350661| -0.055350661|
| 140| 1  | 1.22336697  | -0.22336697  |
| 141| 0.5| 0.721236289| -0.221236289|
| 142| 1  | 0.655910194| 0.344089806 |
| 143| 0.5| 0.847270966| -0.347270966|
| 144| 1  | 1.012782931| -0.012782931|
| 145| 0.5| 1.012782931| -0.512782931|
| 146| 1.5| 1.679797769| -0.179797769|
| 147| 5  | 4.672567844| 0.327432156 |
| 148| 3  | 2.127940416| 0.872059584 |
| 149| 2.5| 1.795311809| 0.704688191 |
| 150| 4  | 4.201313972| -0.201313972|
| 151| 5  | 4.960109711| 0.039890289 |
| 152| 2  | 1.758889556| 0.24110444 |
| 153| 3.5| 4.15208149 | -0.65208149 |
| 154| 8  | 6.566308975| 1.433691025 |
| 155| 3  | 1.977504253| 1.022495747 |
| 156| 0.5| 0.555350661| -0.055350661|
| 157| 1  | 1.012782931| -0.012782931|
| 158| 1.5| 1.673447132| -0.173447132|
| 159| 0.5| 0.721236289| -0.221236289|
| 160| 1  | 1.012782931| -0.012782931|
| 161| 0.5| 0.847270966| -0.347270966|
| 162| 0.5| 0.655910194| -0.155910194|
| 163| 1.5| 1.483470917| 0.016529083 |
| 164| 1  | 1.170168281| -0.170168281|
| 165| 2  | 1.425770879| 0.574229121 |
| 166| 0.5| 0.655910194| -0.155910194|
| 167| 1  | 1.012782931| -0.012782931|
| 168| 0.5| 0.721236289| -0.221236289|
| 169| 0.5| 0.788813651| -0.288813651|
| 170| 1  | 0.847270966| 0.152729034 |
| 171| 2  | 2.040986061| -0.040986061|
| 172| 0.5| 0.788813651| -0.288813651|
| 173| 2  | 2.127940416| -0.127940416|
| 174| 2.5| 3.185944796| -0.685944796|
| 175| 5  | 4.779056549| 0.220943451 |
| 176| 2.5| 1.503556252| 0.996443748 |
| 177| 1.5| 1.483470917| 0.016529083 |
| 178| 2  | 1.963680625| 0.03619375 |
| 179| 0.5| 0.655910194| -0.155910194|
| 180| 3.5| 3.195608377| 0.304391623 |
| 181| 1.5| 1.170168281| 0.329831719 |
| 182| 2  | 1.483470917| 0.516529083 |
| 183| 3  | 1.855218887| 1.144781113 |
3.2.2. Model validation

Independent validation of the model was made on a new database (which has not been previously presented to the NN, neither in the training set nor in the test set) consisting of 45 measured data (15 measurements at the first intersection, 30 measurements at a second location) of the reaction time of children at two different signalized intersections. Table 4 shows the results of model validation.

Table 4. Result of model validation.

| Age | Gender | Dissbil. | moving independ/in a group | Supervis. | MOB TXT | MOB SPEAK | Time of Reaction | Predict |
|-----|--------|----------|---------------------------|-----------|---------|-----------|-----------------|---------|
| 6   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.655910179 |
| 7   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.555350668 |
| 6   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               | 0.847270991 |
| 7   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               | 0.72123629  |
| 7   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.555350668 |
| 7   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               | 0.72123629  |
| 3   | 1      | 0        | 1                         | 0         | 0       | 0         | 1.5             | 1.483470872 |
| 5   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               | 1.012782989 |
| 7   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.555350668 |
| 5   | 0      | 0        | 1                         | 0         | 0       | 0         | 1               | 0.78881364 |
| 1   | 1      | 0        | 1                         | 1         | 0       | 0         | 2               | 2.040986055 |
| 4   | 0      | 0        | 2                         | 1         | 0       | 0         | 2               | 1.805259969 |
| 6   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.655910179 |
| 7   | 1      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.72123629  |
| 6   | 1      | 0        | 1                         | 0         | 0       | 0         | 1               | 0.847270991 |
| 5   | 0      | 0        | 3                         | 0         | 0       | 0         | 2.5             | 3.185944844 |
| 6   | 0      | 0        | 1                         | 0         | 1       | 0         | 3.5             | 4.77905635 |
| 7   | 1      | 0        | 1                         | 0         | 0       | 1         | 2.5             | 1.503556288 |
| 3   | 1      | 0        | 1                         | 0         | 0       | 0         | 1.5             | 1.483470872 |
| 6   | 0      | 0        | 1                         | 0         | 0       | 1         | 2               | 1.963680598 |
| 6   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.655910179 |
| 6   | 0.66   | 0        | 3                         | 0         | 0       | 0         | 3               | 3.195608341 |
| 3   | 0      | 0        | 1                         | 0         | 0       | 0         | 1.5             | 1.170168314 |
| 6   | 0      | 0        | 1                         | 0         | 0       | 0         | 1               | 0.655910179 |
| 7   | 0      | 0        | 1                         | 0         | 0       | 0         | 0.5             | 0.555350668 |
| 6   | 0.5    | 0        | 2                         | 0         | 0       | 0         | 2.5             | 1.855218907 |
Appendix A

The appendix provides explanations for parents regarding the project objectives and examples of approvals given by parents for conducting research involving their children in the Croatian language.

PRIMJERI

SUGLASNOSTI I DOPISA
Informacije o projektu »Problemi u ponašanju djece školske dobi: uloga izvršnih funkcija, individualnih, obiteljskih i genetskih čimbenika-ECLAT«

Dragi roditelji,
obraćamo Vam se molbom da Vi i Vaše dijete sudjelujete u 3. točki projekta o životu i funkcioniranju djece koji provodi Filozofski fakultet Osijek u suradnji s Fakultetom za odgojne i obrazovne znanosti. Istraživanje financiraju Hrvatska zaklada za znanost (HRZZ-IP-2016-06-3917), Sveučilište J. J. Strossmayera u Osijeku (IZIP-2016-81) i Filozofski fakultet Osijek.

1) Koji je cilj istraživanja?
   Kako bismo bili uspješni u životu, potrebna nam je kreativnost, fleksibilnost, samokontrola i disciplina. Zajedničke svim tim osobinama jesu izvršne funkcije koje obuhvaćaju planiranje, fokusiranje i predviđanje ishoda ponašanja. Dosadašnja istraživanja pokazuju da u razvoju izvršnih funkcija djece važnu ulogu imaju roditelji, ali i učitelji. Cilj je istraživanja dobiti što bolji uvid u čimbenike koji mogu utjecati na funkcioniranje djece i njihovu dobrobit.

2) Što trebamo napraviti ako pristanemo sudjelovati?
   Ako pristanete sudjelovati, Vi i Vaše dijete doći ćete, kao i prethodne godine, na Filozofski fakultet Osijek radi provedbe istraživanja. Termin Vašeg dolaska prilagodit ćemo Vašim obvezama. Vaše dijete rješavat će različite zadatke kojima se ispituje način njegova funkcioniranja. Zadaci se ispunjavaju na računalu. Rješavanje zadataka provodi se kroz igru. Vi ćete ispunjavati upitnike o ponašanju i funkcioniranju Vašeg djeteta te Vašim razmišljanjima i ponašanju u različitim odgojnim situacijama. Također ćete ispuniti i upitnike koji se odnose na Vaše svakodnevno funkcioniranje te različite zadatke na računalu (slične onima koje rješava i Vaše dijete). Tijekom rada Vi i Vaše dijete bit će u istoj prostoriji, tako da ćete u bilo kojem trenutku znati što Vaše dijete radi. Istraživanje traje do 90 minuta.

   Također Vas molimo i za dopuštenje da učitelji ispune upitnike o funkcioniranju Vašeg djeteta u školi. Upitnici su jednaki onima koje ćete i Vi ispunjavati. Cilj nam je prikupiti što cjepljenje sliku čimbenika povezanih sa svakodnevnim funkcioniranjem djece. Kao i prethodnih godina, za sudjelovanje u istraživanju i utrošeno vrijeme primit ćete malu kompenzaciju. Vi ćete primiti paket s promotivnim materijalima, dok ćete Vaše dijete dobiti igračku/školski pribor po Vašem izboru.

3) Što ako odbijemo sudjelovati?
   Vaše je sudjelovanje u bilo kojem dijelu istraživanja dobrovoljno i možete ga u bilo kojem trenutku prekinuti bez ikakvih objašnjenja, no s obzirom na važnost ovog istraživanja nadamo se da to neće biti Vaš izbor.
4) Što je s povjerljivošću podataka?

Svi sudionici mogu odustati u bilo kojem trenutku, bez objašnjavanja svojih razloga za odustajanje. Sve su informacije navedene u upitnicima povjerljive i anonimne. To znači da Vaši odgovori nikomu neće biti otkriveni, osim ako je nečiji život u opasnosti ili ako Vi sami ne zatražite razgovor sa stručnom osobom u vezi sa svojim brigama u odgoju djece. Upitnici će biti šifrirani, a šifra koja se povezuje s Vašim imenom bit će dostupna samo istraživačima. U izvještavanju o rezultatima koristit će se samo grupni rezultati, kako se ne bi moglo identificirati Vas ili Vaše dijete. Upitnici će biti pohrani na sigurnom mjestu i samo će im ovlašteni istraživači moći pristupiti radi analize. Slično prethodnoj godini istraživanja, Vaše procjene neće biti dostupne učiteljima, kao što ni njihove neće biti dane na uvid Vama ili nekom drugome.

5) Tko je odobrio istraživanje?

Istraživanje je odobrilo Etičko povjerenstvo Odsjeka za psihologiju Filozofskog fakulteta Osijek (referentni broj: 1/4/2017) te Etičko povjerenstvo za istraživanja Medicinskog fakulteta Osijek. Istraživanje se provodi u skladu s Etičkim kodeksom istraživanja s djecom.

Vaše sudjelovanje iznimno nam je važno za uspjeh ove studije te se nadamo da ćete se odlučiti sudjelovati u istraživanju.

Ako trebate dodatne informacije ili pojašnjenja, molimo Vas da nam se javite (detalji o kontaktima nalaze se pri drugu stranice). Vrlo ćemo rado odgovoriti na sva pitanja koja imate o ovom istraživanju.

Željeli bismo Vam unaprijed zahvaliti na Vašem doprinosu; na temelju podataka koje dobijemo od Vas moći ćemo značajno pridonijeti poboljšanju kvalitete života djece i pomoći Vam u razvijanju potencijala Vaše djece.

HVALA!

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Voditeljica istraživanja
Mobitel studije: 091/602 57 15

doc. dr. sc. Tijana Borovac
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Informirani pristanak roditelja za sudjelovanje u istraživanju odgoja i života djece

Dragi roditelji,

budući da nam je Vaša dobra informiranost o sudjelovanju u ovom istraživanju vrlo značajna, molimo Vas da ispunite ovaj obrazac.

| Vraća li Vam objašnjena svrha istraživanja? | □ Da □ Ne |
|------------------------------------------|--------|

| Jeste li dobili odgovarajuće informacije o istraživanju? | □ Da □ Ne |
|---------------------------------------------------------|--------|

| Imate li kakvih pitanja o istraživanju na koja niste dobili zadovoljavajući odgovor? | □ Da □ Ne |
|----------------------------------------------------------------------------|--------|

| Jeste li bili obaviješteni da su svi podaci koje navedete povjerljivi i anonimni? | □ Da □ Ne |
|----------------------------------------------------------------------------|--------|

| Jeste li razumjeli da je Vaše sudjelovanje dobrovoljno i da možete odustati od sudjelovanja: | □ Da □ Ne |
|---------------------------------------------------------------------------------|--------|

- kada god želite?

| - bez objašnjavanja svojih razloga za odustajanje? | □ Da □ Ne |
|--------------------------------------------------|--------|

Pristajem sudjelovati u ovom istraživanju. □ Da □ Ne

Ime i prezime: __________________________________________________________

Potpis: _____________________________ Datum: ____________
Informirani pristanak roditelja za sudjelovanje djeteta u istraživanju odgoja i života djece

Dragi roditelji,

budući da nam je dobra informiranost svakog roditelja o sudjelovanju djeteta u ovom istraživanju vrlo značajna, molimo Vas da ispunite ovaj obrazac.

| Otpis | Da | Ne |
|-------|----|----|
| Je li Vam objašnjena svrha istraživanja? | | |
| Jeste li dobili odgovarajuće informacije o istraživanju? | | |
| Imate li kakvih pitanja o istraživanju na koja niste dobili zadovoljavajući odgovor? | | |
| Jeste li bili informirani da su svi podaci koje Vaše djetete navedete povjerljivi i anonimni? | | |

Jeste li razumjeli da je sudjelovanje Vašeg djeteta dobrovoljno i da ono može odustati od sudjelovanja:

| Otpis | Da | Ne |
|-------|----|----|
| - kada god želi? | | |
| - bez objašnjavanja svojih razloga za odustajanje? | | |

Suglasan/suglasna sam da moje djetete sudjeluje u ovom istraživanju.  

| Otpis | Da | Ne |
|-------|----|----|
| Suglasan/suglasna sam da se mom djetetu uzme bris iz usta u svrhu prikupljanja DNA | | |
| Dijete je verbalno izrazilo pristanak da mu se uzme bris iz usta | | |

Ime djeteta: ______________________
Ime roditelja/skrbnika: ___________________________________________________

Potpis: ___________________________________________ Datum: ____________