

# MSP Research Note

## SPQ20 Reliability, Validity and Norms

### Introduction

This research note describes the reliability, validity and norms of the SPQ20. Evidence for these technical aspects of the instrument is presented against some of the key the criteria in the EFPA Review Model for the Description and Evaluation of Psychological Tests (Bartram, 2002). The EFPA Review Model was produced to support and encourage the process of harmonising the reviewing of tests. It provides a standard set of criteria to assess the quality of tests. These cover the common areas of test review such as norms, reliability and validity.

### Reliability

#### Internal consistency reliabilities

Table 1 presents internal consistency estimates based on Cronbach's Coefficient Alpha together with raw and Sten score SEMs for the SPQ20. Overall, the SPQ20 has adequate to good internal consistency reliability with a median key factor scale reliability of 0.85 and a median primary scale reliability of 0.7.

- **Dynamism.** The Dynamism key factor reliability is 0.86 and the primary scale reliabilities range from 0.64 to 0.81.

- **Motives and Values.** The Motives and Values key factor reliability is 0.84 and the primary scale reliabilities range from 0.63 to 0.77.
- **Openness.** The Openness key factor reliability is 0.75 and the primary scale reliabilities range from 0.60 to 0.64.

**Table 1.** Internal consistency reliabilities for the SPQ20 (n = 8,927)

Scale	Alpha	Mean	SD	Raw score SEM	Sten score SEM
Dynamism	0.86	76.66	15.99	5.98	0.59
Motives & Values	0.84	86.52	13.85	5.54	0.57
Openness	0.75	59.28	9.90	4.95	0.79
Sociability	0.80	62.05	11.22	5.02	0.70
Anxieties	0.89	42.99	15.39	5.10	0.56
Techniques	0.85	62.83	13.04	5.05	0.67
Competitiveness	0.71	24.18	5.02	2.70	1.18
Aggressiveness	0.64	15.43	5.41	3.25	1.27
Self-Efficacy	0.81	18.52	6.06	2.64	0.95
Flow	0.76	18.53	5.29	2.59	1.08
Achievement	0.77	24.14	5.11	2.45	1.02
Power	0.68	20.54	5.10	2.88	1.09
Conscientiousness	0.76	21.87	5.05	2.47	1.00
Ethics	0.63	19.87	3.84	2.34	1.16
Adaptability	0.64	19.96	4.08	2.45	1.17
Self-Awareness	0.60	20.54	4.56	2.88	1.38
Intuition	0.60	18.77	4.24	2.68	1.28
Relationships	0.62	20.79	4.78	2.95	1.19
Empathy	0.64	19.41	4.41	2.65	1.20
Emotions	0.69	19.22	5.28	2.94	1.17
Competition Anxiety	0.82	16.8	6.28	2.66	0.84
Fear of Failure	0.82	13.95	6.56	2.78	0.87
Burnout	0.69	12.24	5.13	2.86	1.11
Self-Talk	0.77	22.71	5.43	2.60	1.08
Visualization	0.75	19.56	5.62	2.81	0.93
Goal Setting	0.63	20.56	4.75	2.89	1.28
Impression management	0.65	20.01	4.26	2.52	1.16

- **Sociability.** The Sociability key factor reliability is 0.80 and the primary scale reliabilities range from 0.62 to 0.69.
- **Anxieties.** The Anxieties key factor reliability is 0.89 and the primary scale reliabilities range from 0.69 to 0.82.
- **Techniques.** The Techniques key factor reliability is 0.85 and the primary scale reliabilities range from 0.63 to 0.77.

The SPQ20 key factor scale Sten score SEMs range from 0.56 to 0.79 with a mean SEM of 0.65. This indicates that there is a 68% likelihood that the person's true score on one of the key factor scales will about half to one Sten either side of the observed score. For the primary scales, the Sten score SEMs range from 0.84 to 1.38, and the average Sten score SEM is 1.15. The SEM bands around the key factor scores are smaller because the reliabilities are higher.

## Construct Validity

### Scale intercorrelations

Intercorrelations indicate how closely related or independent the SPQ20 scales are. This helps interpretation and throws light on construct validity. Table 2 shows the intercorrelations of the SPQ20 primary scales.

There are predictable links between some of the scales. There are, as you would expect, significant negative correlations between the Dynamism scales and the Anxieties scales, and significant positive correlations between the Dynamism scales and the Techniques scales. For example, there is a strong positive relationship between Flow and Self-Talk, Visualization, and Goal Setting; and, a strong negative correlation between Flow and Competition Anxiety, Fear of Failure and Burnout. There is a similar pattern of correlations between the Self-Efficacy scale and the Anxieties and Techniques scales.

The correlations for the SPQ20 range from -0.77 to 0.77 with three quarters of the intercorrelations falling between -0.49 and 0.49. This indicates a reasonable degree of independence between the scales.

### Intercorrelations and reliability

In order to determine how well a personality assessment instrument differentiates between the different dimensions it is designed to measure, it is necessary to correct the correlations for unreliability. A correlation needs to be divided by the square root of the product of the two variables' reliability to determine what the correlation between the two variables would be if the variables' reliabilities were perfect. If two scales share less than 50% reliable variance, then we can be reasonably certain that they are independent.

Table 3 shows the percentage of common reliable variance for the SPQ20 scales. Seventy four percent of the SPQ20 primary scale pairs share less than 50% common variance indicating that the scales show a fair degree of independence.

**Table 2.** Scale intercorrelations for the SPQ20 (n = 8,927)

Scale	Competitiveness	Aggressiveness	Self-Efficacy	Flow	Achievement	Power	Conscientiousness	Ethics	Adaptability	Self-Awareness	Intuition	Relationships	Empathy	Emotions	Competition Anxiety	Fear of Failure	Burnout	Self-Talk	Visualization	Goal Setting
Competitiveness	1.00	0.15	0.56	0.57	0.71	0.49	0.61	0.15	0.47	0.49	0.47	0.43	0.39	0.40	-0.32	-0.47	-0.48	0.65	0.49	0.51
Aggressiveness		1.00	0.08	0.17	0.07	0.32	-0.04	-0.24	0.05	0.01	0.06	0.05	-0.31	-0.12	-0.10	-0.04	0.04	0.10	0.01	0.04
Self-Efficacy			1.00	0.75	0.49	0.40	0.59	0.11	0.33	0.53	0.53	0.38	0.25	0.61	-0.60	-0.77	-0.63	0.67	0.50	0.47
Flow				1.00	0.51	0.41	0.57	0.09	0.30	0.57	0.47	0.43	0.22	0.61	-0.54	-0.63	-0.61	0.65	0.46	0.52
Achievement					1.00	0.42	0.77	0.19	0.49	0.52	0.45	0.38	0.47	0.38	-0.25	-0.42	-0.47	0.63	0.44	0.58
Power						1.00	0.33	0.04	0.31	0.35	0.30	0.41	0.10	0.27	-0.29	-0.31	-0.32	0.46	0.28	0.39
Conscientiousness							1.00	0.25	0.43	0.56	0.47	0.37	0.49	0.48	-0.34	-0.53	-0.57	0.62	0.45	0.59
Ethics								1.00	0.06	0.30	0.09	0.20	0.41	0.27	-0.08	-0.12	-0.26	0.23	0.11	0.19
Adaptability									1.00	0.35	0.37	0.26	0.32	0.23	-0.15	-0.31	-0.27	0.38	0.40	0.38
Self-Awareness										1.00	0.42	0.46	0.42	0.59	-0.39	-0.49	-0.57	0.60	0.44	0.58
Intuition											1.00	0.27	0.30	0.36	-0.29	-0.47	-0.36	0.44	0.50	0.38
Relationships												1.00	0.40	0.44	-0.29	-0.35	-0.47	0.46	0.25	0.39
Empathy													1.00	0.36	-0.05	-0.23	-0.31	0.35	0.31	0.34
Emotions														1.00	-0.52	-0.55	-0.63	0.59	0.44	0.47
Competition Anxiety															1.00	0.60	0.53	-0.46	-0.29	-0.33
Fear of Failure																1.00	0.62	-0.60	-0.42	-0.42
Burnout																	1.00	-0.66	-0.36	-0.54
Self-Talk																		1.00	0.49	0.61
Visualization																			1.00	0.46
Goal Setting																				1.00

**Table 3.** Percentage of common reliable variance for SPQ20 scales (n =8,927)

Scale	Competitiveness	Aggressiveness	Self-Efficacy	Flow	Achievement	Power	Conscientiousness	Ethics	Adaptability	Self-Awareness	Intuition	Relationships	Empathy	Emotions	Competition Anxiety	Fear of Failure	Burnout	Self-Talk	Visualization	Goal Setting
Competitiveness		0.05	0.55	0.60	0.92	0.50	0.69	0.05	0.49	0.56	0.52	0.42	0.33	0.33	0.18	0.38	0.47	0.77	0.45	0.58
Aggressiveness			0.01	0.06	0.01	0.24	0.00	0.14	0.01	0.00	0.01	0.01	0.23	0.03	0.02	0.00	0.00	0.02	0.00	0.00
Self-Efficacy				0.91	0.38	0.29	0.57	0.02	0.21	0.58	0.58	0.29	0.12	0.67	0.54	0.89	0.71	0.72	0.41	0.43
Flow					0.44	0.33	0.56	0.02	0.19	0.71	0.48	0.39	0.10	0.71	0.47	0.64	0.71	0.72	0.37	0.56
Achievement						0.34	1.01	0.07	0.49	0.59	0.56	0.30	0.45	0.27	0.10	0.28	0.42	0.67	0.34	0.69
Power							0.21	0.00	0.22	0.30	0.22	0.40	0.02	0.16	0.15	0.17	0.22	0.40	0.15	0.36
Conscientiousness								0.13	0.38	0.69	0.48	0.29	0.49	0.44	0.19	0.45	0.62	0.66	0.36	0.73
Ethics									0.01	0.24	0.02	0.10	0.42	0.17	0.01	0.03	0.16	0.11	0.03	0.09
Adaptability										0.32	0.36	0.17	0.25	0.12	0.04	0.18	0.17	0.29	0.33	0.36
Self-Awareness											0.49	0.57	0.46	0.84	0.31	0.49	0.78	0.78	0.43	0.89
Intuition												0.20	0.23	0.31	0.17	0.45	0.31	0.42	0.56	0.38
Relationships													0.40	0.45	0.17	0.24	0.52	0.44	0.13	0.39
Empathy														0.29	0.00	0.10	0.22	0.25	0.20	0.29
Emotions															0.48	0.45	0.70	0.66	0.34	0.47
Competition Anxiety																0.54	0.50	0.40	0.15	0.23
Fear of Failure																	0.68	0.68	0.31	0.37
Burnout																		0.82	0.22	0.62
Self-Talk																			0.42	0.79
Visualization																				0.45
Goal Setting																				

**Table 4.** SEd of SPQ20 scales (n = 8,927)

Scale	Competitiveness	Aggressiveness	Self-Efficacy	Flow	Achievement	Power	Conscientiousness	Ethics	Adaptability	Self-Awareness	Intuition	Relationships	Empathy	Emotions	Competition Anxiety	Fear of Failure	Burnout	Self-Talk	Visualization	Goal Setting
Competitiveness		1.73	1.51	1.59	1.56	1.60	1.54	1.65	1.66	1.82	1.74	1.67	1.68	1.66	1.45	1.46	1.62	1.60	1.50	1.74
Aggressiveness			1.58	1.66	1.63	1.67	1.61	1.72	1.72	1.88	1.81	1.74	1.75	1.73	1.52	1.54	1.68	1.67	1.58	1.81
Self-Efficacy				1.43	1.39	1.44	1.37	1.50	1.50	1.68	1.60	1.52	1.53	1.51	1.27	1.28	1.46	1.44	1.33	1.59
Flow					1.48	1.53	1.47	1.58	1.59	1.75	1.67	1.60	1.61	1.59	1.36	1.38	1.54	1.52	1.42	1.67
Achievement						1.49	1.42	1.55	1.55	1.72	1.64	1.57	1.57	1.55	1.32	1.34	1.50	1.49	1.38	1.64
Power							1.48	1.59	1.60	1.76	1.68	1.61	1.62	1.60	1.38	1.39	1.55	1.54	1.43	1.68
Conscientiousness								1.53	1.53	1.71	1.62	1.55	1.56	1.54	1.30	1.32	1.49	1.47	1.36	1.62
Ethics									1.65	1.81	1.73	1.66	1.67	1.65	1.43	1.45	1.60	1.59	1.49	1.73
Adaptability										1.81	1.73	1.67	1.67	1.65	1.44	1.45	1.61	1.59	1.49	1.73
Self-Awareness											1.89	1.83	1.83	1.82	1.62	1.63	1.77	1.76	1.67	1.89
Intuition												1.75	1.76	1.74	1.53	1.55	1.69	1.68	1.59	1.81
Relationships													1.69	1.67	1.46	1.47	1.63	1.61	1.51	1.75
Empathy														1.68	1.46	1.48	1.63	1.61	1.52	1.76
Emotions															1.44	1.46	1.61	1.60	1.50	1.74
Competition Anxiety																1.21	1.39	1.37	1.25	1.53
Fear of Failure																	1.41	1.39	1.27	1.55
Burnout																		1.55	1.45	1.69
Self-Talk																			1.43	1.68
Visualization																				1.59
Goal Setting																				

## Standard error of difference

The Standard Error of Difference (SEd) helps us determine the size of the gap that you need to see between a person's scores on any two scales before you can conclude that the difference is real. The SEd depends on the reliability of the scales – the higher the reliability the smaller the SEd is. If there are two full SEds between the scores on two scales, then there is a 95% likelihood that there is a real difference.

Table 4 shows the SEds for the SPQ20. The median SEd for the SPQ20 primary scales is 1.59 indicating that a difference of 3 to 4 Stens is likely to indicate a real difference between one scale score and another. In other words, you need to see a difference of 3 or 4 stens (depending on the scales in question) before you can say that an athlete has more mental skills in one area than another. For example, looking at Table 4, you can see that a difference of 3 stens or more is a strong indication that an athlete makes more use of self-talk than visualization.

## Factor analysis

Principal components extraction with varimax rotation was performed on the SPQ20 scales on a sample of 8,927 respondents. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.94, well above 0.6 required for a good factor analysis.

Four factors were extracted with eigenvalues of 1 accounting for 67% of the variance. The variables were on the whole well-defined by the factor solution. Community values were moderate (0.55) to fairly high (0.81) with a median value of 0.71. With a cut-off of 0.45 for the inclusion of a scale in the interpretation of a factor, all the twenty scales loaded on at least one of the four factors. Two of the variables in the solution loaded on more than one factor. These were the Relationships and Empathy scales.

Table 5 shows loadings of variables on factors, communalities, and percents of variance and covariance. Variables are ordered and grouped by size of loading to facilitate interpretation. Loadings under 0.45 (20% of variance) are omitted.

Factor 1 is the first of two big factors made up of 8 scales that we have labelled Mental Toughness: Competition Anxiety (negative loading), Self-Efficacy, Fear of Failure (negative loading), Flow, Burnout (negative loading), Emotions, Self-Talk, and Self-Awareness. In summary, athletes with high scores on Factor 1:

- manage performance anxiety successfully
- have a positive attitude/strong belief in their own capabilities
- frequently perform in the zone
- are physically and mentally fit exhibiting no symptoms of burnout
- control their feelings and emotions
- talk positively to themselves
- are aware of their strengths and improvement areas

Factor 2 is the second big factor made up of 8 scales covering personality traits and performance enhancement techniques that we have labelled Dynamism: Achievement, Adaptability, Competitiveness, Conscientiousness, Visualization, Intuition, Empathy, and Goal Setting. Athletes with high scores on Factor 2:

- are motivated to achieve
- adapt well to new situations and changing circumstances
- compete to win
- are conscientious and organised
- use their instincts and intuition
- are considerate to their fellow players
- use visualization and goal setting techniques

Factor 3 is the first of two small factors that we are calling Sportsmanship. It is based on 3 scales: Ethics, Empathy and Relationships. Athletes with high scores on Factor 3 behave ethically, are considerate to and build relationships with others.

Factor 4 is the second of two small factors that we are calling Leadership. It is based on 3 scales: Aggressiveness, Power, and Relationships. Athletes with high scores on Factor 4 enjoy having control over people, play aggressively but also build relationships with fellow competitors and team players.

### **Relationship to other measures**

In order to assess whether SPQ20 measures the constructs it is designed to measure, we correlated SPQ scale scores with marker variables from the International Personality Item Pool (2001). Table 6 shows the relationships between these marker variables and the SPQ20 scales. The correlations between the SPQ20 scales and the marker variables are in the range of -0.70 to 0.73 with a median correlation of 0.60 suggesting that the SPQ20 trait scales are measuring similar constructs to the IPIP variables.

**Table 5.** Rotated matrix for SPQ20 scales using principal components extraction, varimax rotation (n = 8,927)

Scale	F <sub>1</sub> Mental Toughness	F <sub>2</sub> Dynamism	F <sub>3</sub> Sportsmanship	F <sub>4</sub> Leadership	Communality
Competition Anxiety	-0.82				0.69
Self-Efficacy	0.80				0.81
Fear of Failure	-0.80				0.75
Flow	0.73				0.73
Burnout	-0.72				0.71
Emotions	0.72				0.70
Self-Talk	0.59				0.72
Self-Awareness	0.49				0.62
Achievement		0.77			0.76
Adaptability		0.73			0.55
Competitiveness		0.69			0.71
Conscientiousness		0.67			0.71
Visualization		0.67			0.56
Intuition		0.64			0.55
Goal Setting		0.47			0.55
Ethics			0.76		0.59
Empathy		0.51	0.65		0.71
Relationships			0.52	0.46	0.60
Aggressiveness				0.73	0.72
Power				0.73	0.67
Percent of variance	44.74	9.23	7.89	5.27	
Percent of covariance	66.65	13.75	11.75	7.85	

**Table 6.** Correlations between SPQ20 scales and IPIP marker variables (n = 8,927)

Scale	r	Marker	Ref
Competitiveness	0.62	Like to compete and do everything I can to win	S30
Aggressiveness	0.52	Like to start fights	V127
Self-Efficacy	0.67	Believe that I am important	H740
Flow	0.70	Can stay focused on tasks, even when I'm happy and excited about an upcoming event	D50
Achievement	0.68	Seek to be the best	H276
Power	-0.62	Am not good at taking charge of a group	V105
Conscientiousness	0.64	Am always prepared	X87
Ethics	-0.40	Believe that the end justifies the means	H433
Adaptability	0.48	Am open to ideas	H1142
Self-Awareness	0.60	Always know why I do things	P433
Intuition	0.63	Follow my instincts	H1371
Relationships	0.65	Talk a lot	R11
Empathy	0.52	Appreciate the viewpoints of others	H1340
Emotions	0.63	Can control my emotions	V137
Competition Anxiety	0.73	Am calm even in tense situations	E64
Fear of Failure	0.70	Expect things to fail	H645
Burnout	-0.56	Accomplish a lot of work	H554
Self-Talk	-0.62	Give up easily	H1144
Visualization	-0.70	Have difficulty imagining things	H1382
Goal Setting	0.59	Am a goal-oriented person	V108
Impression management	0.56	Take advantage of others	H427

## Norms

Norms for the SPQ20 (Table 8) were collected on the Internet by offering free assessments. Internet users responding to the free offer completed the questionnaire and a personal details form and received a computer-generated feedback report. This method of norms collection offers test developers the opportunity to collect a very wide range of global norms for an instrument.

The age and gender distribution of the sample is shown in Table 7. Sixty five percent of the sample were men and thirty five percent were women. Fifty three percent were aged up to 20, 24% were aged 21-30, 11% were aged 31-40 and the remaining 12% were over 40.

**Table 7.** Age and gender characteristics of SPQ20 norms (n = 8,927)

Gender	up to 20	21-30	31-40	41-50	51-60	over 60	Total
Women	1839	722	301	179	76	22	3139
% of total	20.60%	8.09%	3.37%	2.01%	0.85%	0.25%	35.16%
Men	2906	1380	718	509	207	68	5788
% of total	32.55%	15.46%	8.04%	5.70%	2.32%	0.76%	64.84%
Total	4745	2102	1019	688	283	90	8927
% of total	53.15%	23.55%	11.41%	7.71%	3.17%	1.01%	100.00%

## Directions for future development

We are currently revising the SPQ20 to improve the technical properties of the instrument – for example, to bring the internal consistency reliability of all the scales above 0.7 and to provide country and athlete specific norms. We will also provide more information about construct and criterion-related validity. We plan to launch an improved test in Autumn 2010 with a revised compute-generated report that provides a more fine-grained analysis and includes development suggestions. We would welcome contact from sport psychologists who would be willing to assist in the SPQ20 development programme.

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**Table 8.** SPQ20 general athlete norms (n = 8,927)

Scale	Sten										Scale	Mean	SD
	1	2	3	4	5	6	7	8	9	10			
Dynamism	0-44	45-52	53-60	61-66	67-76	77-85	86-93	94-100	101-106	107-124	Dynamism	76.66	15.99
Motives & Values	0-59	60-63	64-70	71-79	80-87	88-94	95-100	101-105	106-109	110-124	Motives & Values	86.52	13.85
Openness	0-40	41-45	46-47	48-53	54-58	59-63	64-68	69-73	74-78	79-96	Openness	59.28	9.90
Sociability	0-39	40-45	46-49	50-55	56-62	63-67	68-73	74-77	78-82	83-96	Sociability	62.05	11.22
Anxieties	0-13	14-19	20-26	27-34	35-42	43-49	50-57	58-66	67-74	75-96	Anxieties	42.99	15.39
Techniques	0-39	40-45	46-49	50-55	56-63	64-70	71-77	78-82	83-87	88-96	Techniques	62.83	13.04
Competitiveness	0-12	13-15	16-18	19-21	22-24	25-26	27-28	29-30	31	32	Competitiveness	24.18	5.02
Aggressiveness	0-4	5-6	7-9	10-12	13-15	16-17	18-20	21-23	24-26	27-32	Aggressiveness	15.43	5.41
Self-Efficacy	0-5	6-8	9-11	12-15	16-18	19-21	22-24	25-26	27-28	29-32	Self-Efficacy	18.52	6.06
Flow	0-7	8-9	10-12	13-15	16-18	19-20	21-23	24-25	26-27	28-32	Flow	18.53	5.29
Achievement	0-12	13-15	16-17	18-21	22-24	25-26	27-28	29-30	31	32	Achievement	24.14	5.11
Power	0-9	10-12	13-15	16-17	18-20	21-22	23-25	26-27	28-29	30-32	Power	20.54	5.10
Conscientiousness	0-10	11-13	14-15	16-18	19-21	22-24	25-26	27-28	29-30	31-32	Conscientiousness	21.87	5.05
Ethics	0-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-32	Ethics	19.87	3.84
Adaptability	0-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-32	Adaptability	19.96	4.08
Self-Awareness	0-10	11-13	14-15	16-17	18-20	21-22	23-24	25-26	27-28	29-32	Self-Awareness	20.54	4.56
Intuition	0-9	10-12	13-14	15-16	17-18	19-20	21-22	23-24	25-27	28-32	Intuition	18.77	4.24
Relationships	0-9	10-13	14-15	16-17	18-20	21-22	23-25	26-27	28	29-32	Relationships	20.79	4.78
Empathy	0-12	13-14	15-16	17-19	20-21	22-24	25	26-27	28-29	30-32	Empathy	19.41	4.41
Emotions	0-7	8-10	11-13	14-15	16-18	19-21	22-24	25-26	27-28	29-32	Emotions	19.22	5.28
Competition Anxiety	0-4	5-6	7-9	10-13	14-15	16-19	20-22	23-26	27-29	30-32	Competition Anxiety	16.80	6.28
Fear of Failure	0-1	2-3	4-6	7-9	10-13	14-16	17-20	21-23	24-26	27-32	Fear of Failure	13.95	6.56
Burnout	0-2	3-4	5-6	7-8	9-11	12-14	15-16	17-19	20-22	23-32	Burnout	12.24	5.13
Self-Talk	0-10	11-13	14-15	16-19	20-22	23-25	26-27	28-29	30-31	32	Self-Talk	22.71	5.43
Visualization	0-9	10-12	13-15	16-17	18-20	21-23	24-25	26-28	29	30-32	Visualization	19.56	5.62
Goal Setting	0-10	11-13	14-15	16-17	18-19	20-22	23-25	26-27	28-29	30-32	Goal Setting	20.56	4.75
Impression Management	0-10	11-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-32	Impression Management	20.01	4.26

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