

## **Humor ratings of bad jokes are modulated by other people's laughter for neurotypical and autistic adults.**

Qing Cai, Sinead Chen, Sarah J White, Sophie K Scott

Laughter is a positive vocal emotional expression: although associated with humor, most laughter is found in social interactions [1]. We are overwhelmingly more likely to laugh when we are with other people [1], and laughter can play a very important communicative role [2]. Laughter may be processed differently in autism: typically developing children's enjoyment of cartoons is enhanced by laughter tracks, watching with another, or simulating a smile. In contrast, autistic children's enjoyment is not significantly modulated by such manipulations [3].

In the current study we investigated the influence of laughter on the ratings of how funny jokes are perceived to be, presenting spoken jokes onto which we edited posed and spontaneous laughter [4]. This is an implicit measure of the effects of laughter as the laughter was technically irrelevant to the task at hand, and we studied these effects in both neurotypical and autistic participants.

Although most laughter is not linked to overt expressions of humor [1,2], we do laugh at jokes and comedy, and filmed comedy is frequently broadcast with a recorded laughter track, often recorded from the studio audience. Recorded laughter (live or prerecorded) was used to indicate to radio and TV audiences that shows were intended to be humorous and to help them feel part of an 'audience'. Might, however, the presence and nature of the laughter also implicitly affect how funny the comedy *itself* is perceived to be? We hypothesized that if so, the addition of laughter and the kind of laughter would positively modulate humor ratings of jokes. We tested this by asking participants to rate how funny they found jokes: the jokes were read aloud by a professional comedian, and the jokes themselves were so-called 'dad jokes' (aka 'groan-worthy' jokes). We deliberately used weaker jokes so that we could avoid ceiling effects when determining any influence of laughter.

We first established baseline mean ratings of how funny the jokes were perceived to be on a 1-7 scale. We next presented a different group of participants (neurotypical group n= 48, autistic adult group n=24) with the same jokes: now half of the jokes were paired with examples of short spontaneous laughs, and the other half were paired with short posed laughs. Two different pseudo-randomized sets of jokes and laughs were created, such that all participants rated each joke only once, but across all participants, all jokes were heard with both different kinds of laugh.

The addition of laughter increases how funny the jokes are perceived to be: there is a significant difference between the baseline ratings and the joke+laughter ratings of the neurotypical adults, irrespective of type of laughter (see figure 1, S1). Second, the increase in perceived humorousness is modulated by the kind of laughter: the addition of spontaneous laughs leads to jokes being rated as funnier than the addition of posed laughs.

(figure 1 here)

There was no difference between the neurotypical and autistic adult participants in the effect the different types of laughter had on the ratings of the jokes. Both groups gave higher funniness ratings for jokes paired with spontaneous laughter than with posed laughter: there was a main effect of laughter type on humor ratings and no interaction with participant group. This suggests that the laughter is being implicitly processed by all the participants: not only its presence, but the kind of laughter. This pattern was maintained in a second analysis with a subgroup of the neurotypical participants ( $n=24$ ) who were closely matched to the autistic adults on age, sex and IQ measures (figure 1, S1). The only difference, across both analyses, was an increased rating of the funniness of *all* the jokes by the participants with a diagnosis of autism; this may be because the neurotypical adults were more aware that these 'dad jokes' are considered to be childish and uncool, while the autistic adults were more open to such jokes. There are studies showing that the perception of humor involving complex social scenarios is reduced in autistic individuals, while individuals with autism find slapstick and puns to be highly humorous [5].

Strikingly, everyone found jokes funnier when paired with spontaneous laughter. Perhaps this is due to our autistic participants being high functioning, perhaps similar performance patterns can rest on distinctly different neural systems [6,7], or perhaps laughter is implicitly processed by autistic individuals in the same way as their neurotypical peers. Indeed, autistic children do show behavioural contagion of yawning and laughter, but compared to neurotypical controls they are much more sensitive to the context of the task and whether they know the laugher/yawner [8]. Replications and extensions of the current study may determine whether the inclusion of such modulations reveals similar differences between neurotypical and autistic adults on the implicit processing of laughter.

The funniness of jokes is thus influenced by laughter, for both neurotypical and autistic adults: what remains unclear is the underlying mechanism – are there effects of behavioral contagion [1], or effects of the perceived 'approval' which another's laughter may signify? Laughter and humor are distinctly different phenomena [1,2,4], though the perception of both is influenced socially. The funniness of a joke can be affected by who tells it [9] and by the cultural origins of the joke [10]: in the current study funniness is modulated by the presence and intensity of laughter. Laughter is an extremely salient and important social cue and although laughter can be commonplace, it always carries a wealth of critical social and emotional meaning [2], and we process it even if we are not directed specifically to engage with the laughter [2]. These data indicate that implicit processing of laughter can influence the perceived funniness of a fairly dire joke, and that more spontaneous laughter has the strongest effects.

Laughter tracks were initially introduced because listeners did not always realize that radio comedies were meant to be funny. Our data suggest that laughter may also influence how funny the comedy itself is perceived to be, and that people with autism are equally sensitive to this effect. This might suggest that comedy and laughter could be more accessible to people with autism than it is typically considered to be.

## Supplemental Information

Supplemental Information includes information about the participants, stimuli details, and experimental procedures, and can be found with this article online at \*bxs.

## Declaration of Interests

None of the authors has any competing interests to disclose.

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**Figure 1 – mean humor ratings given by Baseline group (BL; n=20; shown in red) and by the Autism group (n=26) and Neurotypical subgroup (NT; n=24) when paired with laughter. Jokes with spontaneous laughter (J+Spontaneous Laughter) are shown in blue and jokes with posed laughter (J+Posed Laughter) are shown in green. Each dot represents the mean rating of each joke. Error bars represent standard error of the mean.**

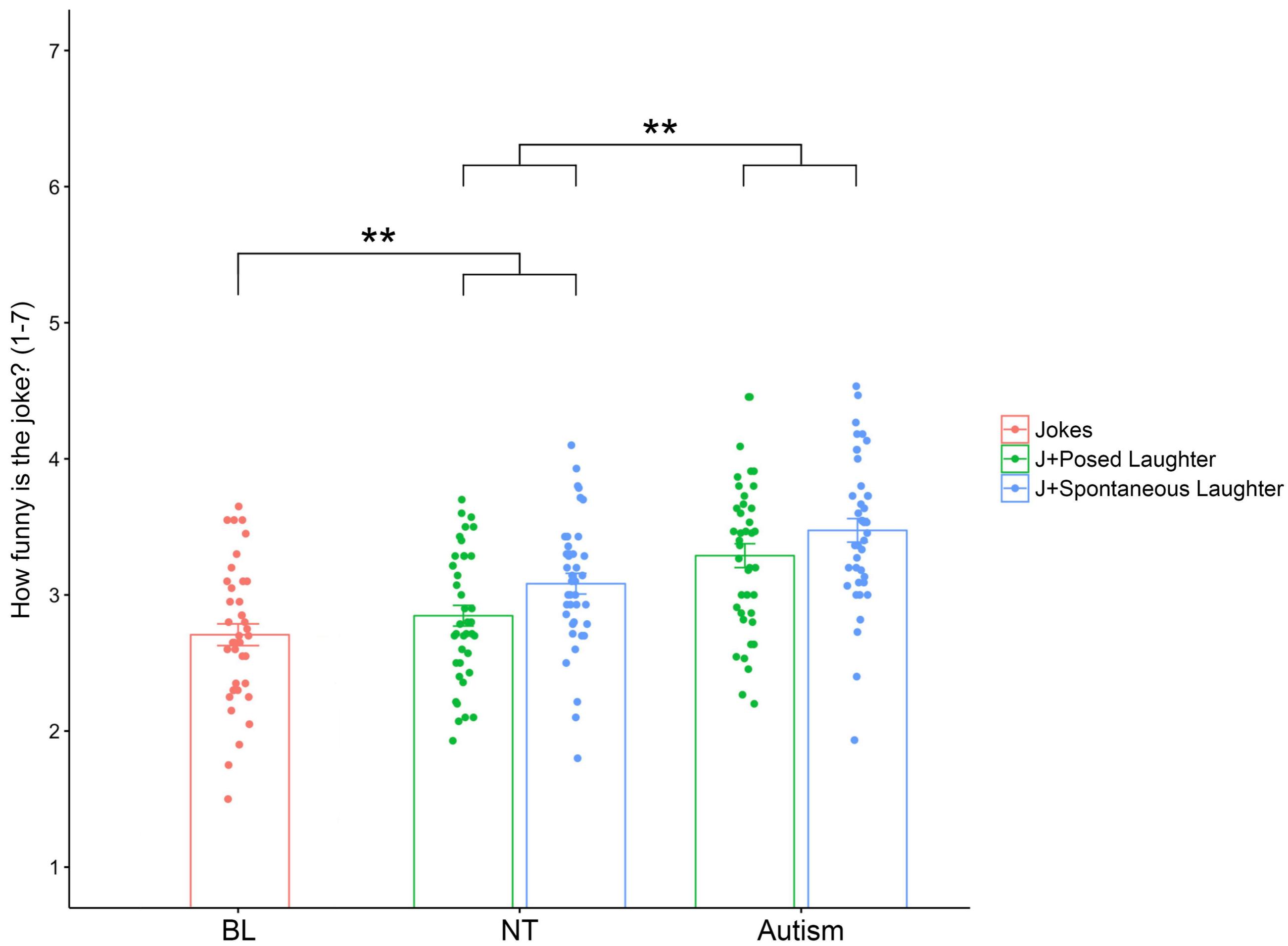
### **Supplemental Information**

**Document S1** contains details of the participants tested, the statistical analyses on their data, the joke and laughter stimuli, the full experimental design and procedure, and two figures.

**eTOC Blurb Cai et al show that laughter influences the perception of humour: adding laughter onto jokes increases their funniness ratings, across neurotypical and autistic participants; the use of spontaneous laughter enhances this. The neurotypical participants rated all the jokes as less funny, which may reflect their appraisal of the very weak jokes used.**

### **Individual author contributions**

SC created the laughter stimuli. QC, SKS and SJW designed the study. QC and SKS recorded and edited the joke stimuli. QC ran the experimental study with supervision by SJW. QC performed the statistical analyses. SKS QC and SJW wrote the paper.



<b>Jokes</b>	<b>Set 1</b>	<b>Set 2</b>
<u>J01</u>	<u>J01</u> + SpL	<u>J01</u> + PoL
...	...	...
J20	J20 + SpL	J20 + PoL
J21	J21 + PoL	J21 + SpL
...	...	...
J40	J40 + PoL	J40 + SpL

